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PIPE LINE INDUSTRY

APRIL
1961

A SPECIAL REPORT — AUTOMATIC CONTROL AND COMMUNICATIONS

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DEVELOPMENTS TO WATCH
Communications/Control: The Future 36

FIRST REPORT
New Ways to Detect Batch Interfaces 42

FOR REMOTE COMPRESSORS
Computers Control Pockets to Save Fuel 50

FOR CRUDE LINES
'Off-the-Shelf' Components Are Big Need 55

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PIPE LINE INDUSTRY

A GULF PUBLISHING COMPANY PUBLICATION

April 1961 Vol. 14, No. 4

CONTENTS and Quick Look

To help you put first things first, scan these time-saving digests, checking √ those you want to read first.

AUTOMATIC CONTROL AND COMMUNICATIONS

Developments to Watch in the Fields of Communications and Control

☐ Recent breakthroughs in electronics have taken the lid off many of the limitations in range, frequency and speed. Sophisticated communications and instrumentation lie ahead: soon we will be able to transmit millions of conversations simultaneously over a single channel and soon we will be able to extend the frequency of our microwave radio systems.

By Donald M. Taylor.....Page 36

Humble Reports on New Methods of Batch Detection

☐ Two new instruments pin-point interfaces. Both work on somewhat similar principles. They use the increase or decrease in specific gravity to affect the energy in a vibrating member. One courses a small stream of line fluid through a hollow tuning fork. Any changes in densities affect changes in frequencies of vibrations. The other method is based on a vibrating paddle immersed in line fluid. The changes in densities alter the resonant characteristics and consequently the amplitude of vibrations it will transmit.

By Ray Pfrehm.....Page 42

New Ideas in Microwave Spark Design of Magnolia's West Texas System

☐ Here are some samples of the innovations: concrete buildings that may thwart hunters; bilateral switching for hot standby units can go in either direction in 55 milliseconds; independent east-west switchover directed by the fault sensing equipment which can make decisions in 800 milliseconds, and unusually low-noise performance.

By Richard L. Luthans.....Page 45

Look for More Computers at Compressor Stations in the Future

☐ Pipe line companies are interested in maintaining a reasonably small labor force and in equipment which can increase efficiency of stations. The pipe line companies are forced into this position by the difficulties occasioned by competition in the fuel markets and rising prices. The saving of fuel gas is sizable if the pocket settings on reciprocating compressors are carefully watched. Analog computers can accomplish this. Page 50

What Crude Lines Need Most in the Field of Automatic Control

☐ The biggest task at hand is to achieve some degree of standardization. Instruments now have too many *exotic* features which are unnecessary—for example, the *'exotic'* non-standard, instruction manuals and wiring diagrams. Time something was done.

By Allen R. Heidebrecht.....Page 55

Objective for Engineers: Systems Optimization

☐ Take a look at our needs and our methods of meeting increased demands. We often increase the size of our installations without full knowledge of the hundreds of factors which affect its transient behavior. What we need is a "mathematical pilot plant" set up in a computer to help us actually achieve our optimum design.

By Carlton C. Homan, Jr.....Page 57

Integrally Reinforced Forgings for Branch Connections

☐ Stress concentrations in branch connections have long plagued pipe line companies. Insert butt-welding nozzles with smooth tapered design are providing relief from this problem.

By William M. Jackson.....Page 58

The 'Ugly American' Gets a Face Lifting

☐ People in other nations have been seeing a distorted, one-sided and unlikable picture of foreign-based American businessmen. Now a revolutionary new school is helping overseas personnel learn how to show the other side of the coin. Read this interesting article on international public relations.

By Kerryn King.....Page 62

REGULARLY MONTHLY DEPARTMENTS

Editorial Page.....4
Pipe Line Panorama.....35
Ideas for the Future.....66
Pipe Line Hints.....68
Construction News.....71
On the Line.....80
Pipe Line Men in the News.....82
Who's Meeting Where.....89
Service and Supply Men.....92
Classified Advertising.....97
What's New in Equipment.....100
New Equipment Literature.....116
ADVERTISERS' INDEX.....118

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Gas Pipelining at the Crossroads

THE NEXT MONTH will be an important one for the future of the gas transmission industry. First, there should come some clarification of Federal Power Commission personnel, policies and practices. The uncertainty whether the Commission has *one* chairman, *two or which* is symbolic of conditions, generally.

Hearings on the nominations of Howard Morgan and Joseph Swidler have been set for April 11. Nominee Swindler had been proposed as chairman also, but Jerome K. Kuykendall presently holds that position and his FPC term does not expire until June 1962.

Added factors are the views and proposals of James M. Landis, President Kennedy's adviser on regulatory agencies; these are aimed at speeding and smoothing the working of governmental agencies. Like sin and virtue, everyone seems to be against dragging FPC delays and for safeguarding the interests of all segments of the industry and the consumer.

Here are some of the key Landis suggestions:

- Exempt the small producers (upwards of 80 percent produce less than 20 percent of the gas)
- Enlarge the FPC to seven members, with two panels of three plus a Chairman. One panel would concentrate on gas matters, the other on electric cases. The chairman could be ex-officio on either panel and in the event of a tie among four commissioners the entire Commission could decide the case.
- Establish a definite formula for those producers regulated and expedite cases.
- Seek legislation, where necessary, to speed up and improve regulatory action.
- Have a Presidential advisor to observe the regulatory agencies and report trouble spots to the agency and the President.

Why Action Is Needed. The FPC reported at the end of February that construction permit applications totaling nearly $850 million were pending. Some applications are more than three years old. By the time many of these applications are granted, costs will have increased many millions of dollars over the estimate made when the initial application was filed. This increase in cost has to come from somewhere, and in many cases it is taken out of the pockets of all segments of the industry. Including the consumer whose interests the Commission supposedly wishes most to protect.

Now the natural gas industry is the fifth largest in the nation. Capital investment is more than four times the 1945 total. It will cost more money to expand the gas pipe line systems to meet growing demands . . . much more. Will that money come from additional investments with adequate earning incentives for the regulated companies? Right now it is anybody's guess.

One Way Out. In an effort to reach a solution to present difficult gas supply problems, pipe line companies are showing greater interest in purchase of large blocks of gas in place. As Harold Burrow, Tennessee Gas Transmission Company president, explained in Houston recently . . . " These are installment plan purchases . . . what we have done is to purchase a lease or leases . . . we have made a down payment and will pay the balance on the installment plan." TGT is not the first pipe line purchaser of in-place reserves. Texas Eastern Transmission Corporation acquired some $134 million of gas reserves in the Rayne, La., gas field in a comparable way in June 1959.

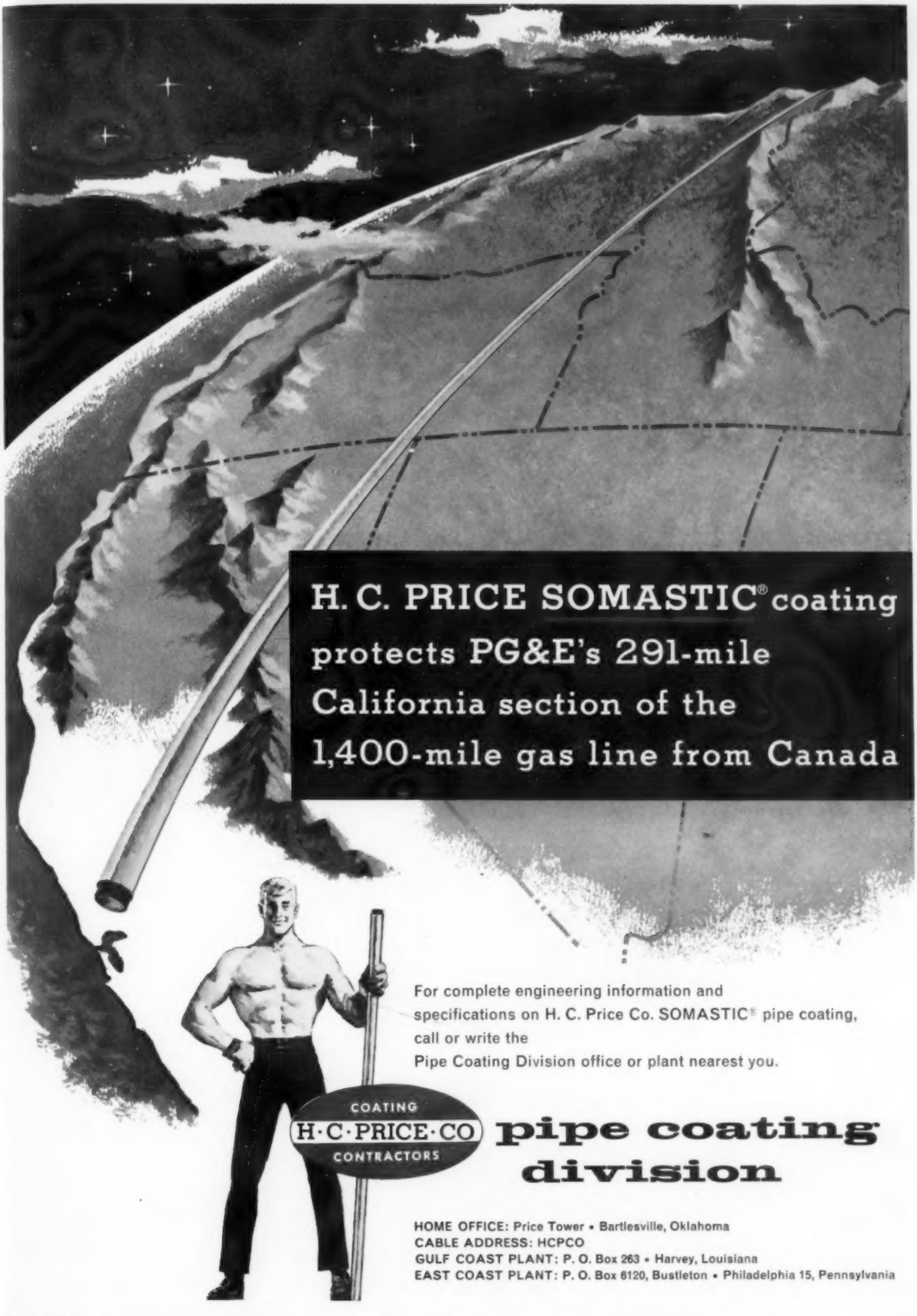
Since the Supreme Court's decision in the CATCO—Tennessee Gas case, the producer's unwillingness to contract large packages of gas reserves in interstate commerce has mounted.

Of course the FPC has the basic right to investigate any price in a matter under its jurisdiction; but before the CATCO—TGT decision, it was the FPC staff responsibility to prove that the price in an initial sale was too high. Then if a price reduction should be made after an investigation later it would only go into effect at that time and would not be retroactive. Plenty of natural gas reserves were available.

After the Supreme Court decision in the CATCO—TGT case, the burden of proof as to price shifted to the producer even in an initial contract. Producers could be hit with price conditions in a certificate, and any regulatory delays worked against them.

To make sure it will have enough natural gas to meet fast growing demands, Tennessee Gas has spent, *or will spend,* $325 million for in-place natural gas reserves in three South Louisiana areas. These are the Bastian Bay, Ship Shoal and MCN purchases which TGT President Burrow spoke about recently.

It is hoped that this method of purchasing gas reserves will help to relieve some of the burden on the FPC and the entire gas industry. Along with this, let's hope for a speed-up and simplification of FPC procedures that will be fair and productive for pipe lines, producers, distributors and the consumers as well.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PIPE LINE INDUSTRY and The PIPE LINE CATALOG for the oil and gas pipe line industry.

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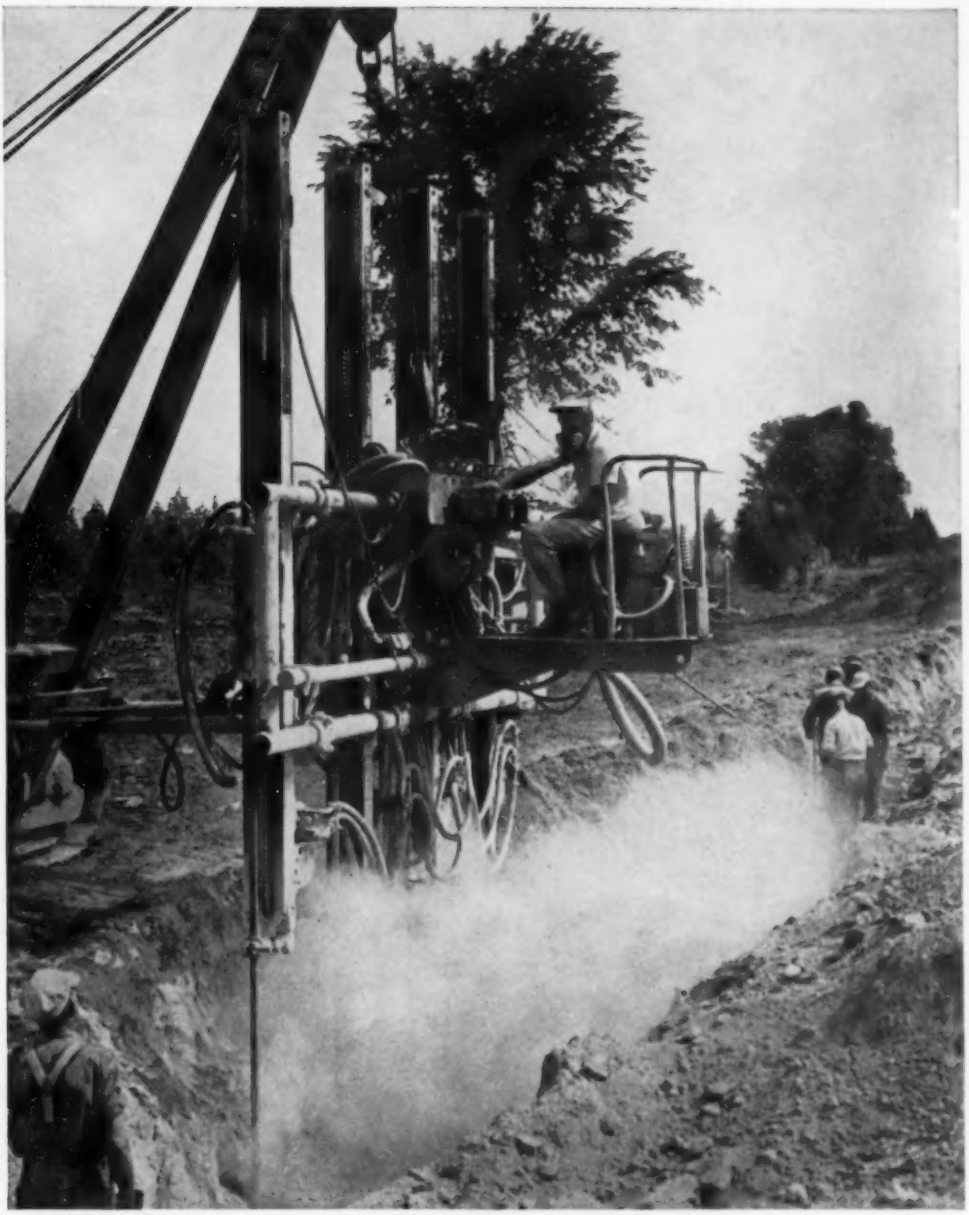

One way to keep costs down and your spread on schedule is to have a Gardner-Denver "Quadril" ready when your trenching crew runs into rock. The "Quadril" puts four hard-hitting rock drills under the control of a single operator . . . drills holes to 12′ depths without a steel change. And compared to twin-type drilling rigs, "Quadril" saves three drillers, a tractor, and tractor operator. Write for bulletin.

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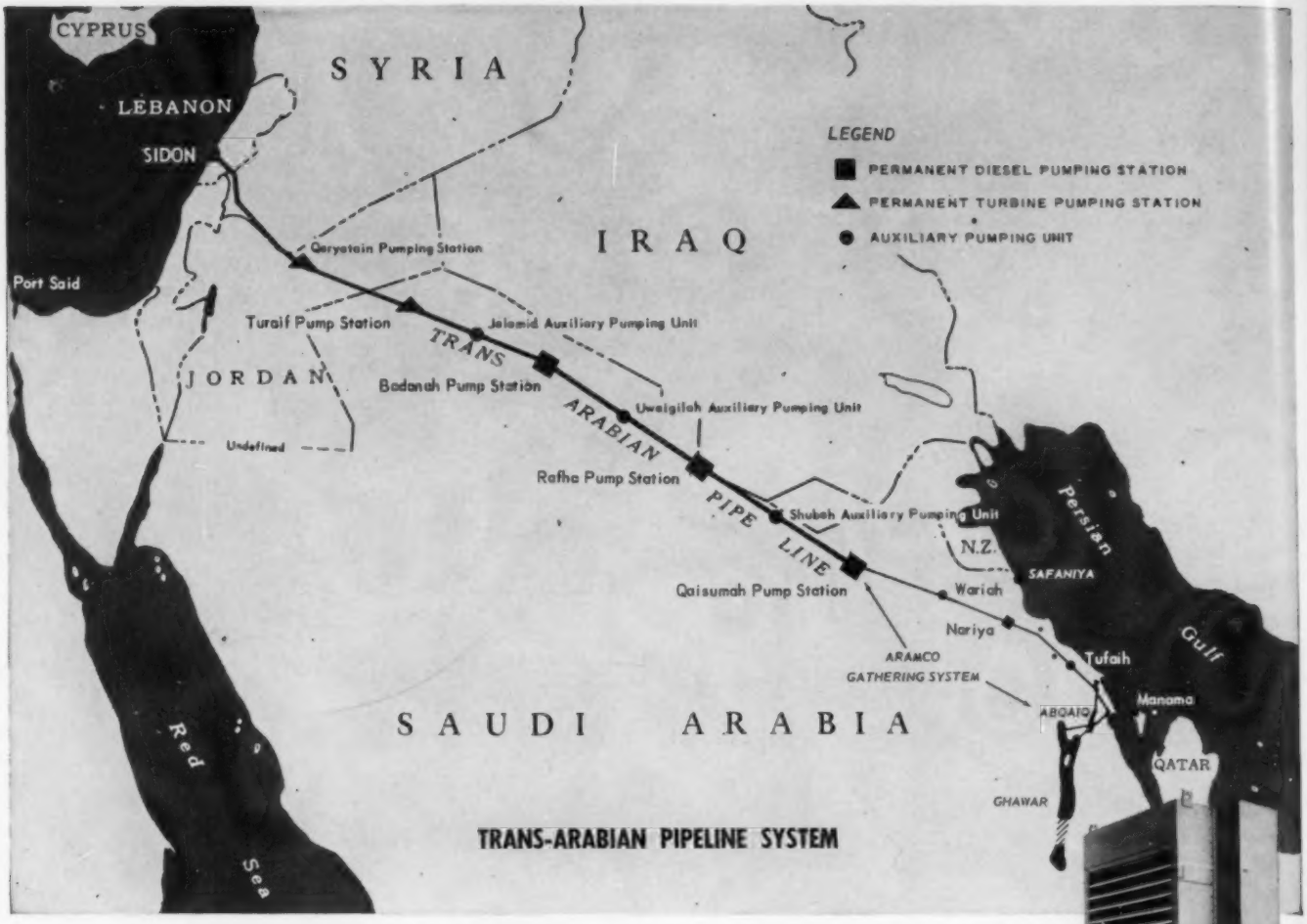

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BETTER AIR IS OUR BUSINESS

M. H. Raven (right), Superintendent of Northern Natural Gas Company's underground storage compressor station near Redfield, Iowa, until his recent promotion, discusses the facts with H. E. Hansen, Shift Engineer. Compressor in foreground is GMWA-8, rated 2000 hp. Another similar unit is in the background.

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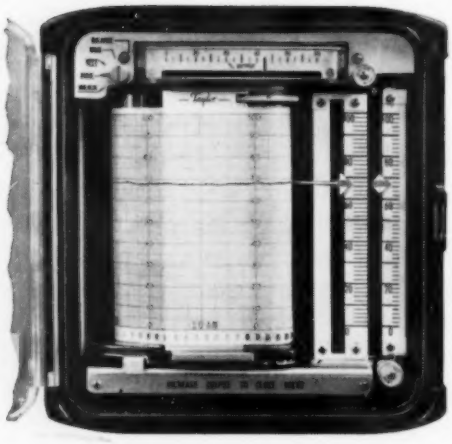

No. 707T Electronic DP Transmitter (Left)

- Extremely reliable for unattended stations. Has no vacuum tubes, no transistors. Unaffected by vibration.
- Ideal for use where paraffin is present because nothing exposed to the process except end plates (steel or 316 stainless steel) and 316 stainless steel diaphragms.
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No. 700J AC or DC Electronic Recorder (Left)

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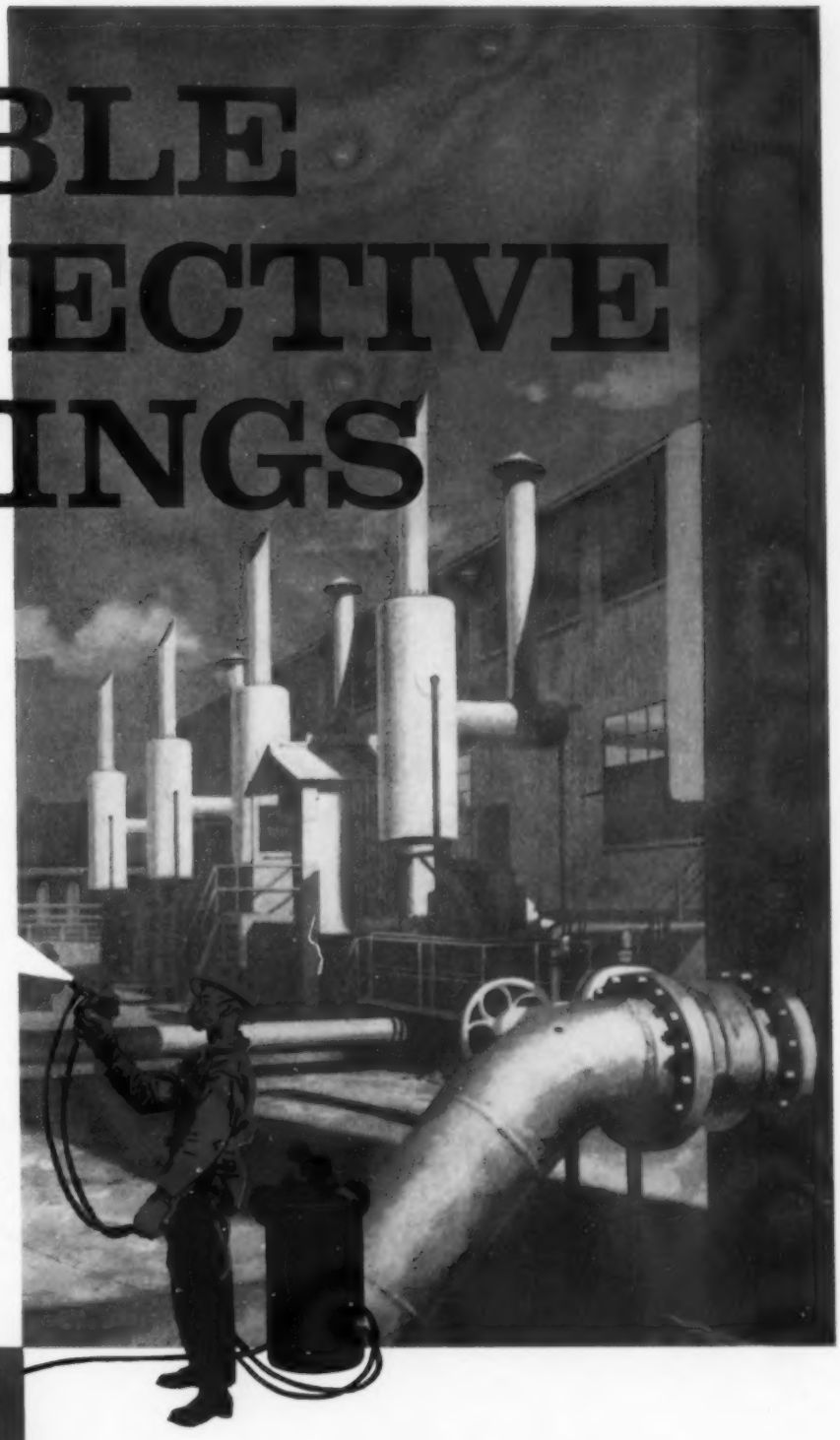
HUMBLE PROTECTIVE COATINGS



Off the press soon—the handbook of Humble Protective Coatings gives you new weapons to fight the high cost of corrosion.

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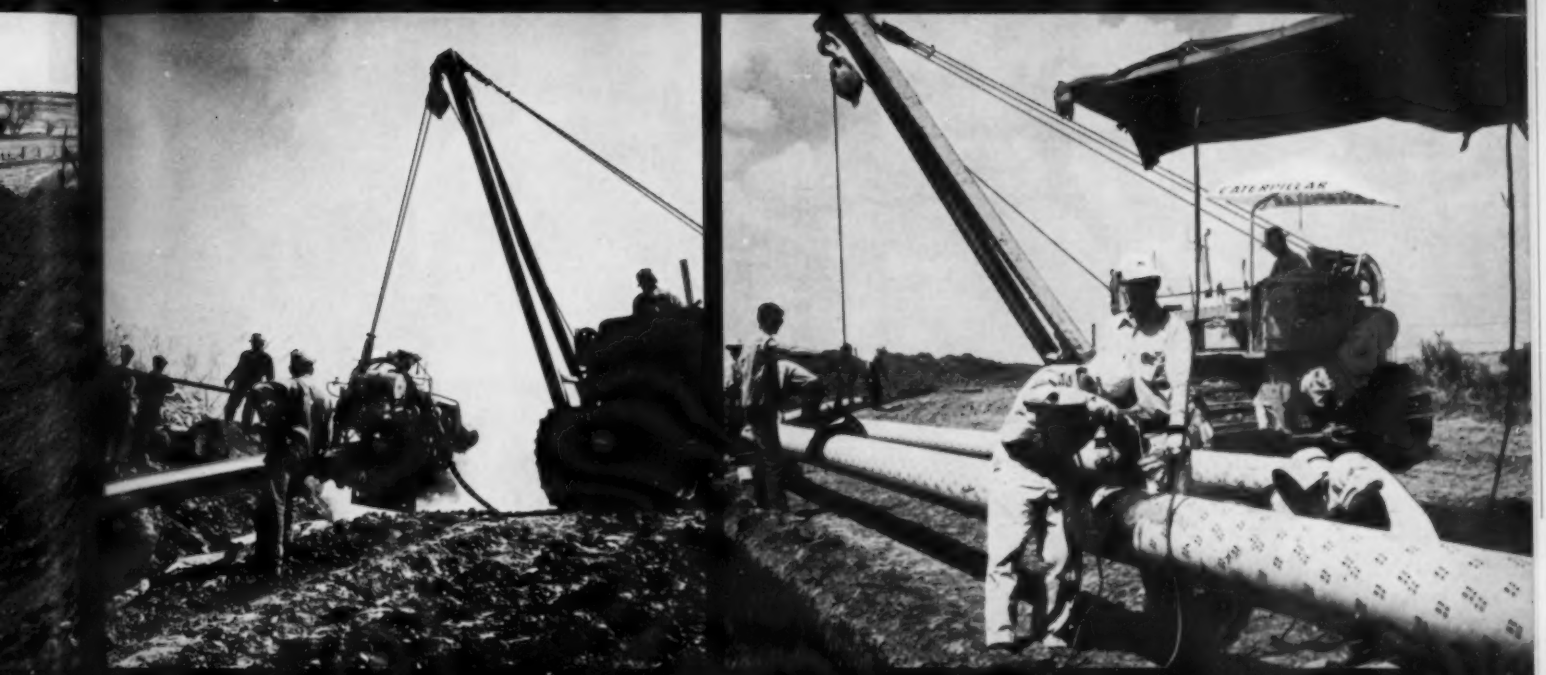

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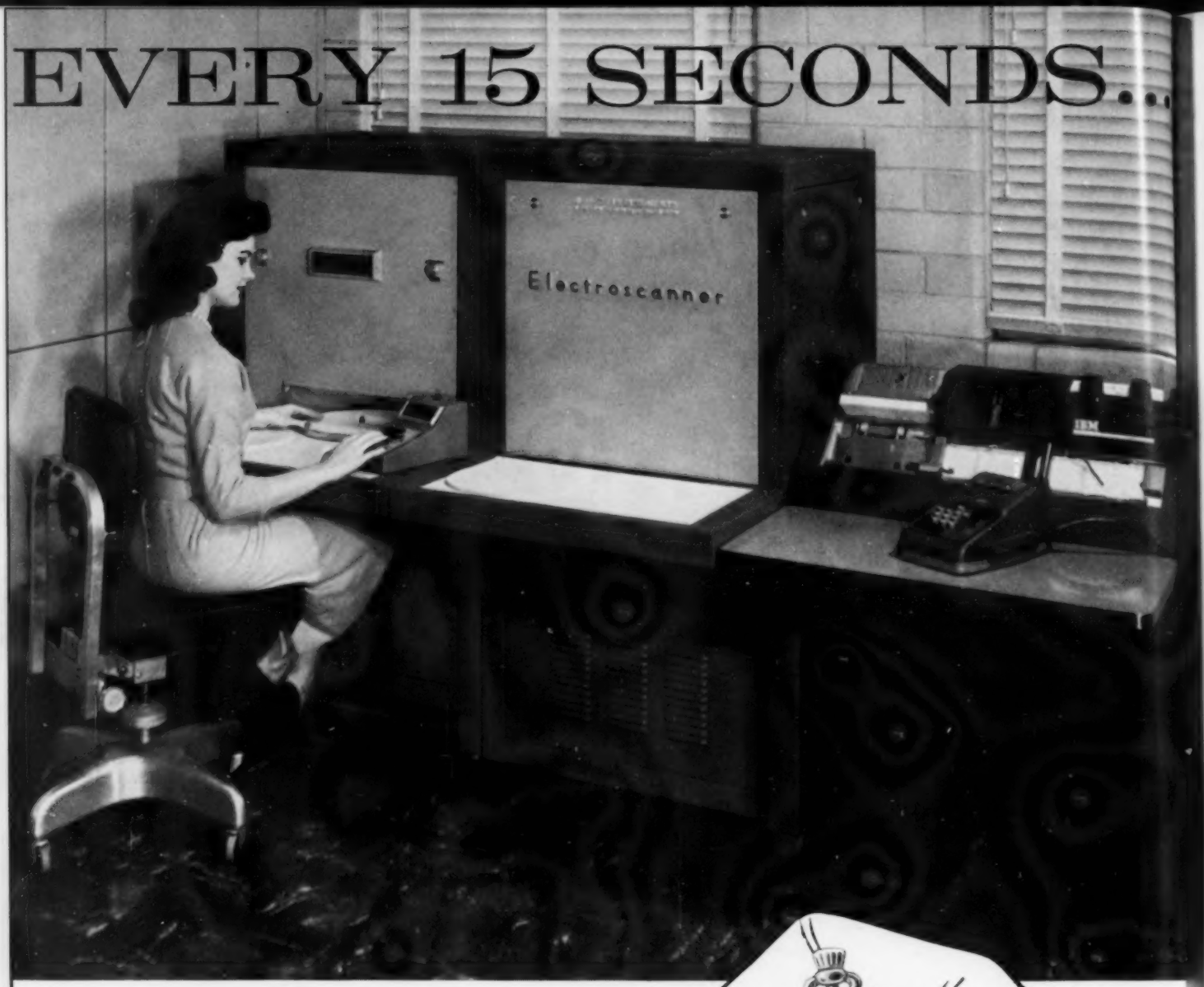

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Garlock Teflon* Piston Rings may be used alone where piston is lightweight, vertically installed, or supported by tail rod (upper left). On large compressors and cylinders with heavy pistons, Teflon Rider Rings are recommended to support the piston (lower left).

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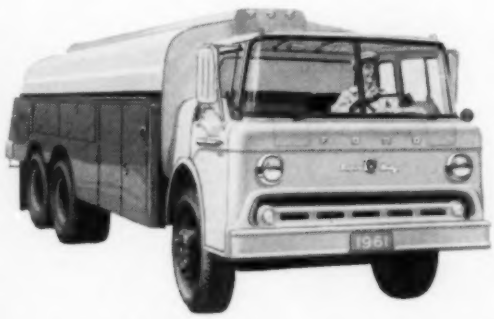
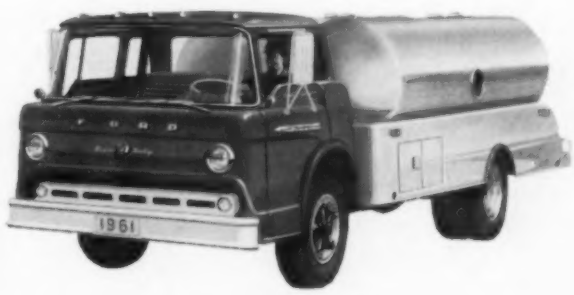
- **Now 222 money-saving Tilts, Tandems and Conventionals with Super Duty V-8's to choose from!**

Ford's rigid quality control program gives you unsurpassed dependability! Positive evidence of uniformly high production and inspection standards is the exclusive new 100,000-mile engine warranty. On 401-, 477- and 534-cu. in. Super Duty V-8 engines, each major engine part (including block, heads, crankshaft, valves, pistons, rings), when engine is used in normal service, is warranted by your dealer against defects in material or workmanship for 100,000 miles or 24 months, whichever comes first. Warranty covers the full cost of replacement parts . . . full labor costs for the first year or 50,000 miles, sliding percentage scale thereafter.

In addition, an extended warranty covers all 1961 Ford Trucks of any size. Each part, except tires and tubes, is now warranted by your dealer against defects in material or workmanship for 12 months or 12,000 miles, whichever comes first. The warranty does not apply, of course, to normal maintenance service or to the replacement as normal maintenance of such items as filters, spark plugs and ignition points. No other truck gives you such protection for your investment; never before could you be so confident of long-range durability!

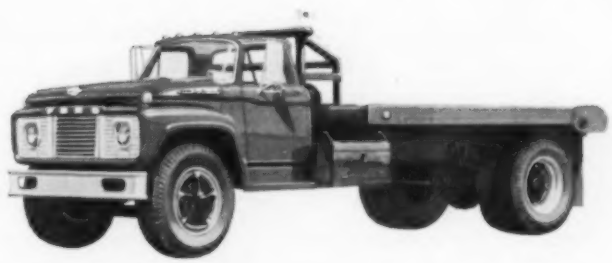


Tandem Axle models are available with tilt cabs. As with conventional tandems, aluminum walking beams, wheels, fuel tanks are offered to cut weight.



Most popular Tilt Cabs on the American road! 1961 models represent five years of improvements. Four series—up to 36,000-lb. GVW, 65,000-lb. GCW.

New tougher tandems offer greater strength in chassis, cab and sheet metal . . . new wide-track front end stability. Powered by rugged Super Duty V-8's, Ford tandems go up to 51,000-lb. GVW, 75,000-lb. GCW.



New huskier conventional trucks feature lighter, stronger frames of high-tensile steel . . . heavier gauge metal and stress-isolating independent mounting for radiator, fenders and cab.

QUALITY-BUILT... MAINTENANCE-ENGINEERED

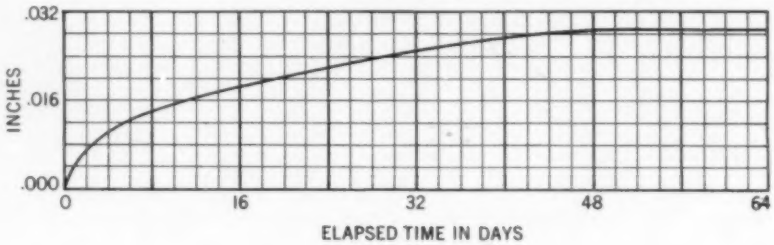
FORD TRUCKS COST LESS

NEWS FROM DOWN THE LINE!

Are all pipeline insulators as alike as two peas in a pod?

They're not alike, not in physical properties! When plastic insulators first became available for pipeline use, WmSON felt they were inferior to the steel and block types then available. We delayed our entry into the field until we could provide a plastic material to withstand field abuse and wear. We found that material in a high density polyethylene which could be injection molded to provide low cost insulators of the highest quality.

Our decision has proved sound. Breakage and excessive wear of glass fibre reinforced plastics, particularly in large sizes, has created a lack of confidence in plastics in general, but the M-2 Plastic THINsulator® has proved its stamina. Its high resistance to cold flow has been proved. Deflection test results: 1000 p.s.i. on each THINsulator runner for 64 days — total cumulative deflection only 0.029". Max. temp. during test, 105° F., min. temp., 75° F.



Its low coefficient of friction causes it to slide easily inside casing. The M-2 is completely resistant to impact fracture (4.0 ft. lbs./in. notched) and has successfully worked on 36" pipe, ½" wall, pulled in excess of 500 feet. We are convinced that it will perform as well or better than any other insulator on the market, including all known steel types. Other physical properties: *Dielectric strength* — (short time, ⅛" thickness) 500 volts per .001 inches (D149-55T); *Tensile strength* — 4400 p.s.i. at 20 in./min.; *Elongation* — 25% 20 in./min.; *Abrasion resistance* — Taber index 5.7.

The increased acceptance of the M-2 THINsulator has brought production to a level of real economy in injection molding. These cost savings are being reflected in new WmSON prices for 1961.

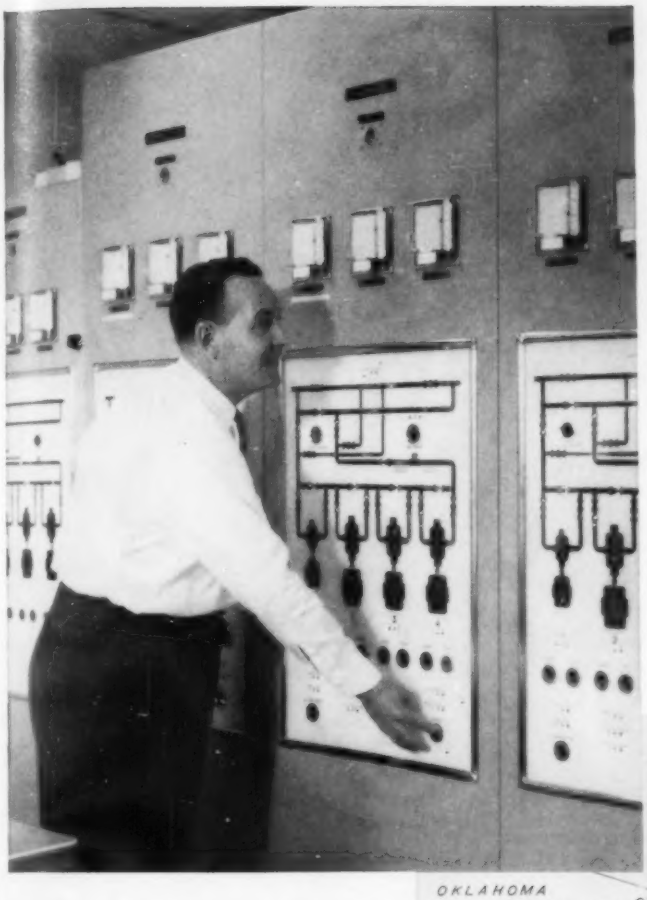
In planning '61 cased crossings, don't pay a premium for other insulators — use WmSON engineered M-2's and save!

T.D. Williamson, Inc.

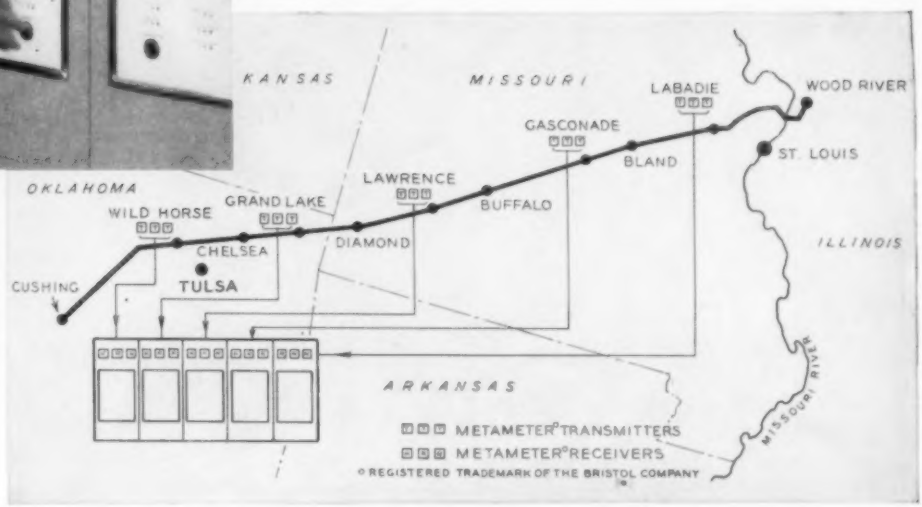
P. O. BOX 40 • TULSA 2, OKLAHOMA

REPRESENTATIVES AROUND THE WORLD

Bristol telemetering "mans" half the stations on 400-mile crude oil pipeline



Miniature Bristol Metameter® Telemeter Recorders (top row) on central supervisory control panel at Cushing office of Shell Pipe Line Corporation. Instruments, occupying only 5″x5¼″ on panel, indicate and make permanent record of suction, case, and discharge pressure at each of five unmanned stations along 400-mile pipe line. (See map.)



Bristol Metameter* system permits efficient, instantaneous supervision from central office, frees valuable personnel from routine duties.

Midcontinent Division of Shell Pipe Line Corporation, Houston, Texas, uses a Bristol Metameter System for telemetering on the Ozark Pipe Line System, a 400-mile pipe line from Cushing, Oklahoma, to Wood River, Illinois. This system is jointly owned by Shell Pipe Line Corporation and The Texas Pipe Line Company and is operated by Shell Pipe Line.

The Bristol Metameter telemetering system brings pressure readings from five unmanned pumping stations (out of 10 stations in all) along the pipe line into the central dispatching office in Cushing, Oklahoma. (See map.) Using the telemetered readings, the Cushing office can exercise complete supervisory control over pump operation at the unattended stations. Every other station along the line is manned, including the junction point, Cushing, and the terminus at Wood River. This puts personnel within a reasonable distance to take corrective action if trouble develops.

Whether they're used on oil pipe lines, natural gas pipe lines or distribution systems, electric power systems, water plants, or in steel mills or other industrial plants, Bristol telemeters can practically always improve operating efficiency and cut costs. Their accurate, precise readings are transmitted with the speed of radio (VHF, UHF, microwave), or telephone or carrier current lines for distances that may vary from a few yards to hundreds of miles. Pressure, liquid level, flow (including total corrected flow), temperature, mechanical motion, voltage, current, and power are just a few of the variables that can be transmitted.

Bristol developments in industrial telemetering, soundly based on more than 45 years' experience in this field, are making possible today a speed and an effectiveness in central supervisory control that would have been undreamed of only a few years ago. Let us give you full details. Write: The Bristol Company, 114 Bristol Road, Waterbury 20, Conn.

**T. M. Reg. U. S. Pat. Off.* 0-19

long lengths for economy

Long lengths of pipe mean fewer welds in the field . . . and fewer welds mean greater economy. It's as simple as that.

Bethlehem produces electric resistance-weld line pipe in lengths to 62 ft. Diameters range from 5 5/16 in. through 16 in. OD. It's all first-rate pipe, meeting API 5L (Grades A or B) or 5LX (X42, X46, or X52) specifications.

We make ERW pipe at Sparrows Point, Md., where we also produce continuous buttweld line pipe in sizes from ½ in. through 4½ in. OD in strict conformity with API 5L specifications.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

BETHLEHEM STEEL

For a full line of line pipe

...thick walls

3/4 in. →

for safety

When pipe lines pass through built-up areas, safety becomes a primary consideration. The applicable codes often demand special practices, including thick-walled pipe.

That's where Bethlehem comes in. We make line pipe with ¾-in. walls from 18 in. through 42 in. OD, in 40-ft lengths. In fact, we are supplying a major gas transmission company with 36-in. OD pipe with walls measuring .844!

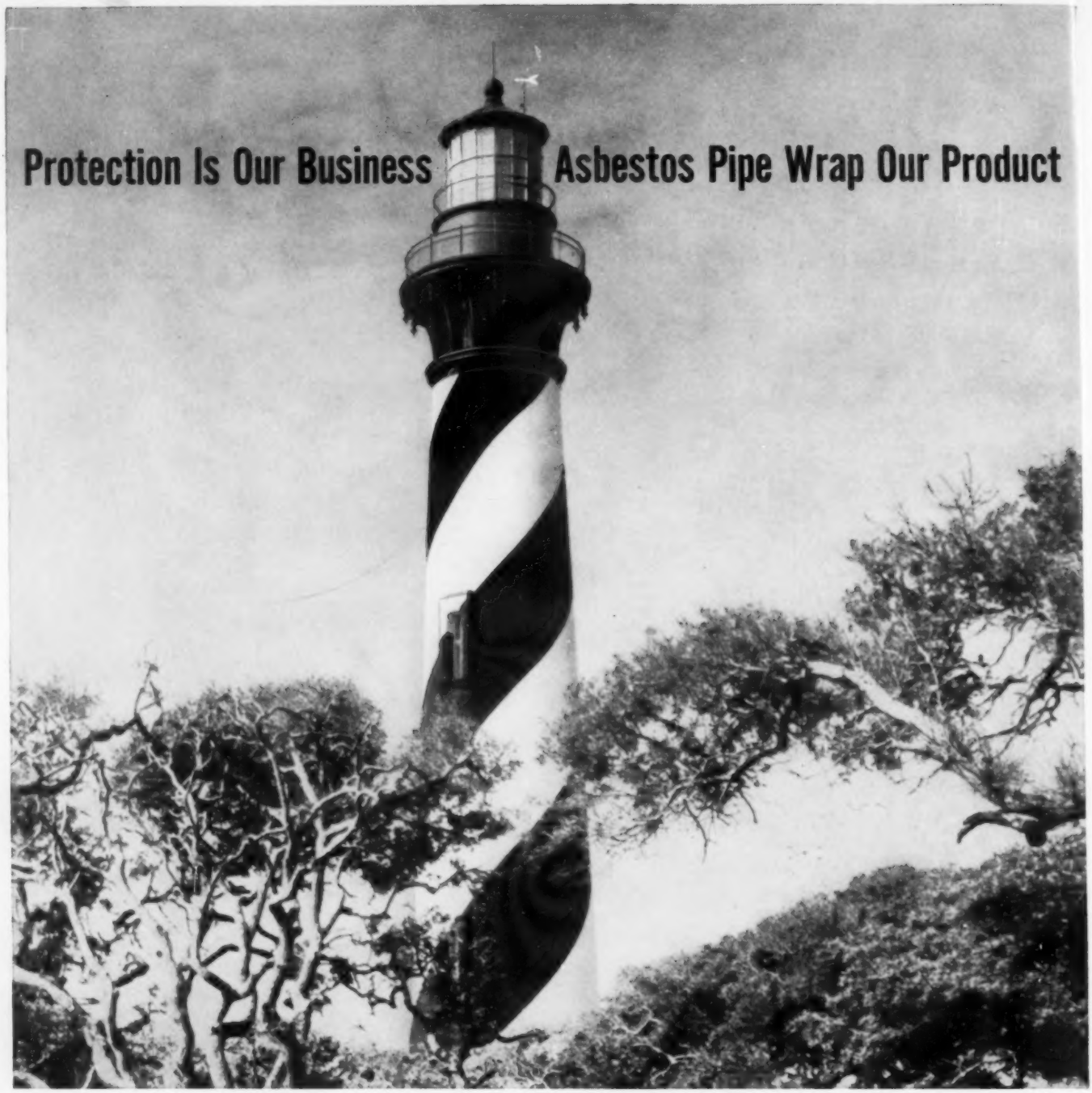
Bethlehem's large-diameter line pipe is electric fusion-welded and cold-expanded at our Steelton, Pa., mill—probably the most modern in the industry.

Steel

for Strength
... Economy
... Versatility

Export Sales: Bethlehem Steel Export Corporation

call BETHLEHEM STEEL



Through complete Quality Control—Nicolet Asbestos Pipe Line Felts have received universal acceptance for their uniformity and absolute dependability. ■ Whether your pipe line requirements demand Nicolet Asbestos #15 "Standard", #8 "Tufbestos" or #10 "Reflecto" (the new, improved, white Asbestos Felt) you are assured of getting the best protection obtainable. ■ And now—the addition of "Old Nic" Glass Wrap to this family of Pipe Wrap products makes Nicolet your best source for complete pipe line protection. ■ "Old Nic" Glass Wrap has uniform porosity which allows hot tar or asphalt enamel to bleed through, while letting hot gas escape, minimizing "holidays". "Old Nic" Glass Wrap will most effectively protect yard wrapped pipe against impact damage. It is equally effective in over-the-ditch operations. ■ **Write today for full specifications and samples of Nicolet pipe protection products.**

Distributed throughout the United States

NICOLET INDUSTRIES, INC.

FLORHAM PARK, NEW JERSEY

sophisticated piping systems call for *SWEEPOLETS*® . . . today's newest concept in branch pipe construction.

In a primary atomic reactor shell, Sweepolets provide the best possible method of reducing stresses at the branch connections. Sweepolets were used recently for this application at one of the Government's largest atomic installations.

SWEEPOLETS®

BONNEY

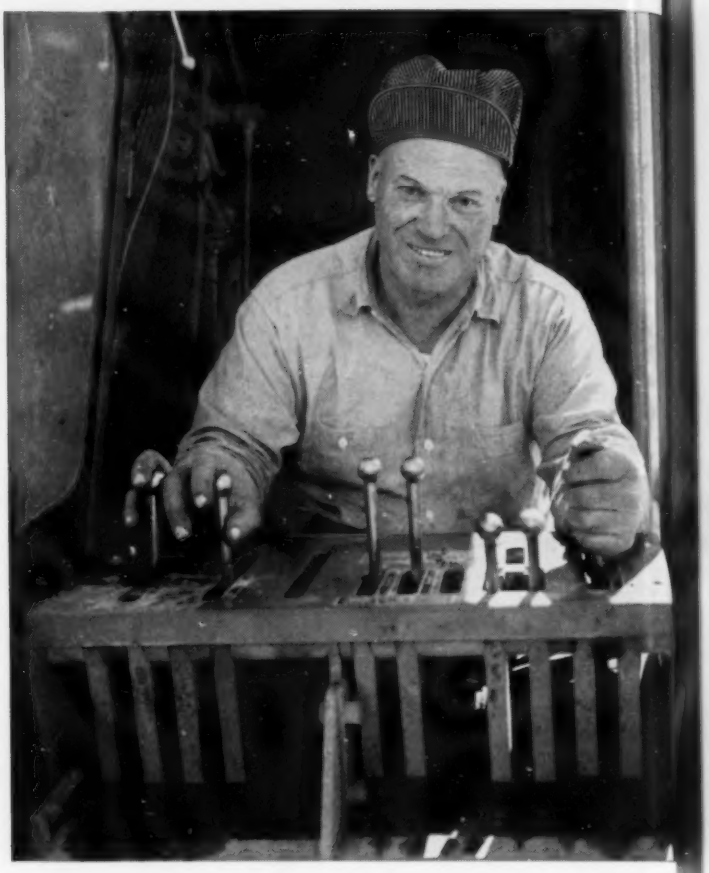
also exclusive manufacturers of

WELDOLETS®
THREDOLETS®
SOCKOLETS®
ELBOLETS®
BRAZOLETS®

CARBON STEEL
STAINLESS
ALLOY
for all services

BONNEY FORGE AND TOOL WORKS, ALLENTOWN, PENNSYLVANIA

Straight talk



on shovel-crane controls

ONLY ONE SHOVEL-CRANE MAKER FULLY UTILIZES TRUE POWER-HYDRAULIC CONTROLS

Until recently, other shovel-crane builders completely ignored power-hydraulic controls, or were content to merely augment their outdated mechanical controls with booster-type systems — so-called "power" controls. Only in the last few years have some of these manufacturers begun to offer a power-hydraulic control, *though strictly on a limited basis* . . . not on all models and not for all machine functions. Some machines even employ 3 different control systems.

Now look at Link-Belt Speeder. The company first pioneered power-hydraulic controls for shovel-cranes in 1936, 25 years ago. Then, in 1954, Link-Belt Speeder made this modern, proven Speed-o-Matic system standard on every machine in its wide line. Today, the controls are used for every machine function . . . *are the same on each and every rig.*

JUST NUDGE THE LEVER

The years-ahead Speed-o-Matic system employs the instantaneous force of oil under pressure — all the way from the control levers to the operating clutches. And, since oil is noncompressible, clutches respond the instant additional pressure is metered into the clutch lines. Absolutely no wait for pressure to build up.

Short-throw Speed-o-Matic control levers are panel-mounted for operator convenience and ease. By simply nudging one or more of these levers, a crane operator, for example, can boom up or down, hoist or lower a load, swing, travel . . . independently or in suitable combinations. And every machine response is **instantaneous, oil-smooth, precise!**

For example, on a machine equipped with reversing clutch (or clutches) on the operating drums, the Speed-o-Matic operator can power down the heaviest or lightest loads with hairline accuracy. Fingertip-sensitive control levers provide exact in-hand feel of the load.

AIR CONTROLS TEND TO LAG

How many manufacturers actually *recommend* air controls for crane work . . . especially on the swing . . . or on the hoist, for that matter? Waiting for pressure to build up can be serious business, resulting in a dangerous lag. The operator cannot expect the same degree of precision and safety as with instantly responsive power hydraulics.

With the Speed-o-Matic system, hydraulic lines are constantly full of oil, permitting the operator to meter the desired pressure to the various clutches without the hazards of waiting for build-up. For *more pressure,* he merely eases the lever forward (or reverse). To *release,* he returns the lever to neutral.

AIR CONTROLS DEMAND EXTRA SERVICE

Air controls, for one, present their share of servicing headaches. Dirt and moisture prove a major worry . . . not to mention freezing, filter maintenance and other downtime annoyances. And most components of these systems are purchased from outside sources.

The Speed-o-Matic system, on the other hand, is

For more data on advertised products, use Readers' Service Cards, last page.

unaffected by normal changes in temperature or atmosphere, and requires only seasonal oil changes. It's an open system, *with no need to prime or bleed.* Basically it's the same reliable system used on aircraft. And all components of this modern system (except pump) are designed and manufactured by Link-Belt Speeder.

POWER-ASSISTED CONTROLS FALL SHORT

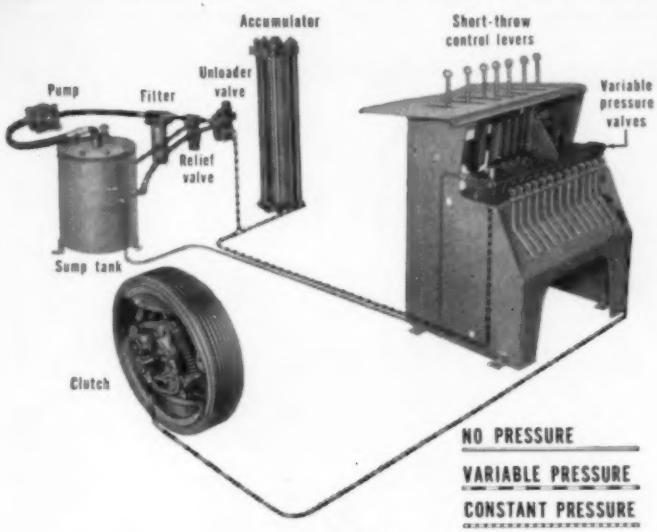
Manual hydraulic, air or mechanical booster systems offer a power assist to just a limited number of shovel-crane functions . . . **not all operations,** as with Speed-o-Matic. On some machines, to illustrate this point, only the main operating drums benefit from power controls, and on some mechanical booster systems, it is recommended that the booster be disengaged for crane work.

MECHANICAL CONTROLS DEPEND ON MUSCLE

Obsolete long-lever controls, of course, enjoy no power assist whatsoever. Still used on small machines, they are bulky and slow; they hand-fight the operator, contribute to his fatigue, hold down his production . . . require frequent adjusting. They simply do not compare to power controls.

SPEED-O-MATIC POWER-HYDRAULIC SYSTEM LETS OIL UNDER PRESSURE DO THE WORK

By means of variable pressure control valves, the operator meters oil pressure to each operating clutch. For more pressure, he lengthens the stroke of the lever to increase the force of the spring. This, in turn, moves the piston to admit more oil from the



valve bank. Response is prompt, positive and smooth. Pressure at the valve bank is kept constant (between 900 and 1050 psi) by the system's accumulator, which explains why the engine-driven pump operates against pressure only 5% of the time.

CLUTCHES SELF-ADJUSTING

Speed-o-Matic eliminates more than 150 working parts. There are no bushings, pins, links, clutch toggles. All actuating mechanism is oil-immersed. A micronic-type, replaceable oil filter keeps oil clean.

Interchangeable Speed-o-Matic clutches require far less operator attention. Even minor adjustments are spread weeks or months apart. Why? Hydraulic-actuated pistons automatically compensate for normal lining wear, heat expansion or temperature changes.

SPEED-O-MATIC CONTROLS BRING OUT THE FULL PRODUCTIVE POTENTIAL OF THE RIG — BRING OUT THE BEST IN THE OPERATOR. Speed-o-Matic increases cycles up to 25% more per shift than manually controlled machines. Featured above is the ¾-yd. LS-78 mounted on the all-new tractor-type lower, designed especially for work-and-travel jobs. 115-61N

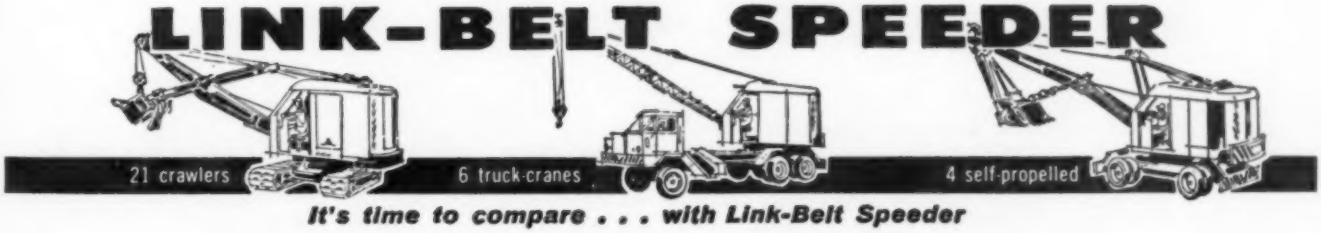
PERFORMANCE AND PROFITS—A LONG-RANGE LOOK

Today, shovel-crane buyers simply cannot afford to relegate machine controls to secondary importance . . . cannot afford to buy experiments. A less efficient control system can penalize a rig in performance and profits for years to come.

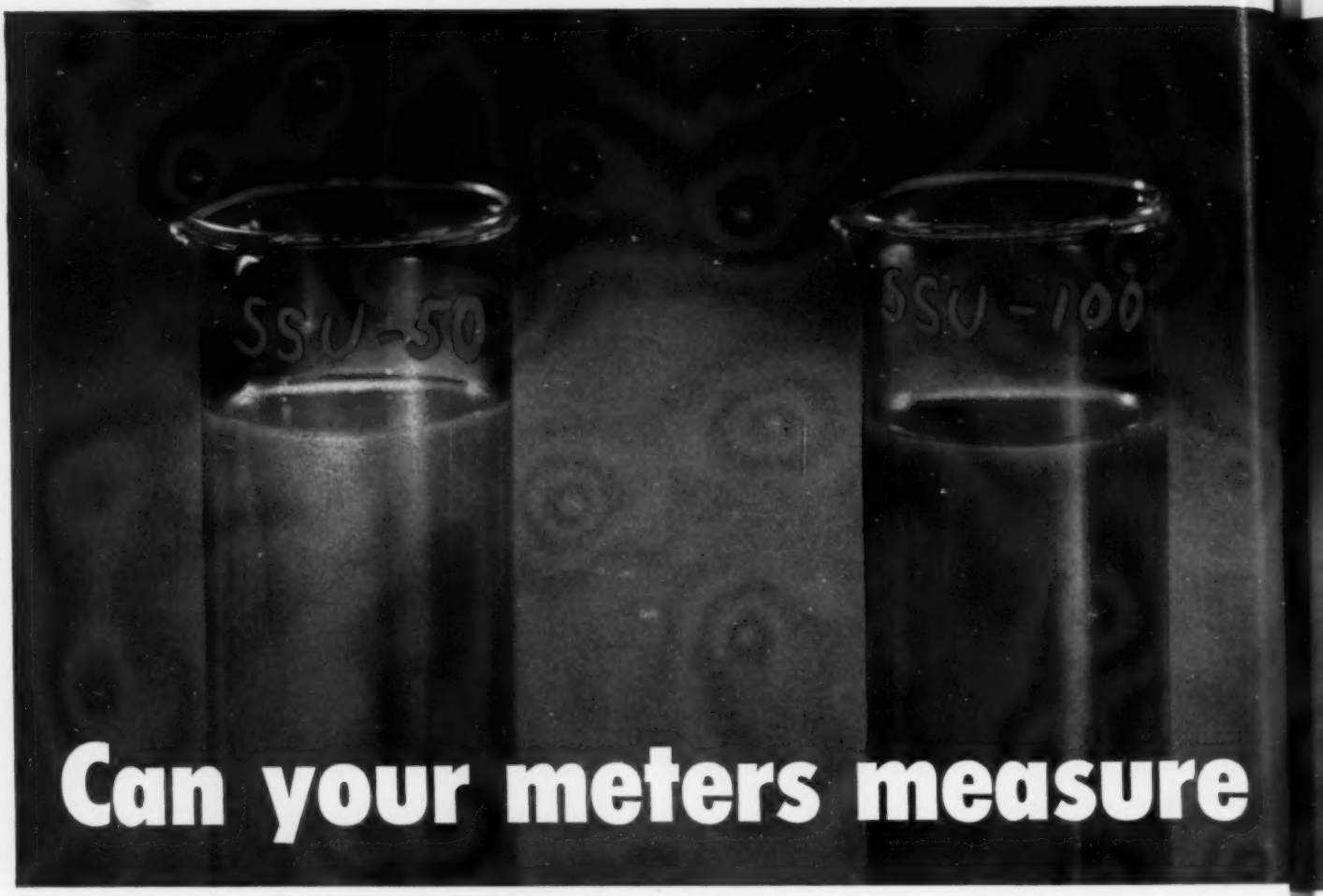
See your local Link-Belt Speeder distributor for details, or write for illustrated literature. LINK-BELT SPEEDER CORPORATION, Cedar Rapids, Iowa.

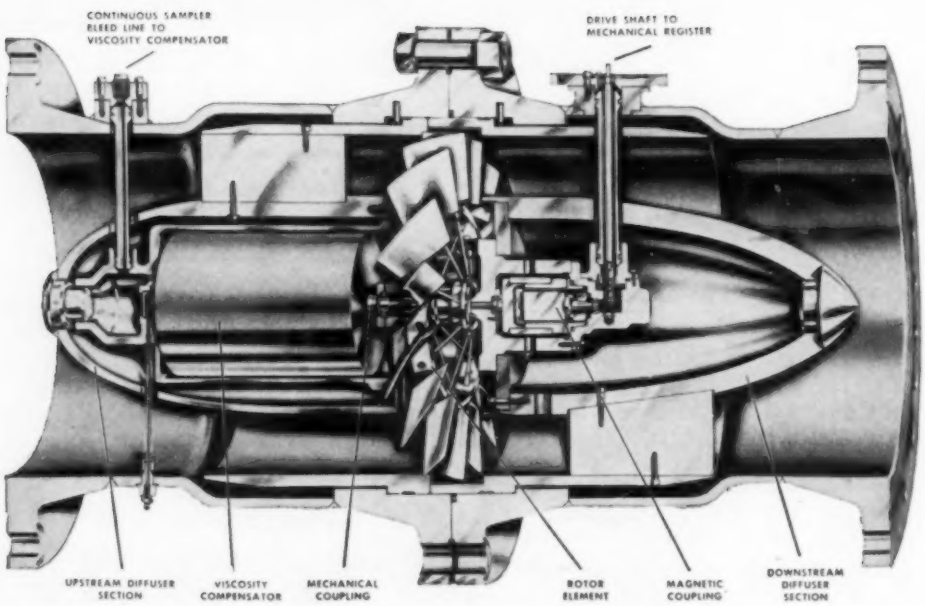
1936 - 1961 . . . 25th ANNIVERSARY OF SPEED-O-MATIC CONTROLS

LINK-BELT SPEEDER



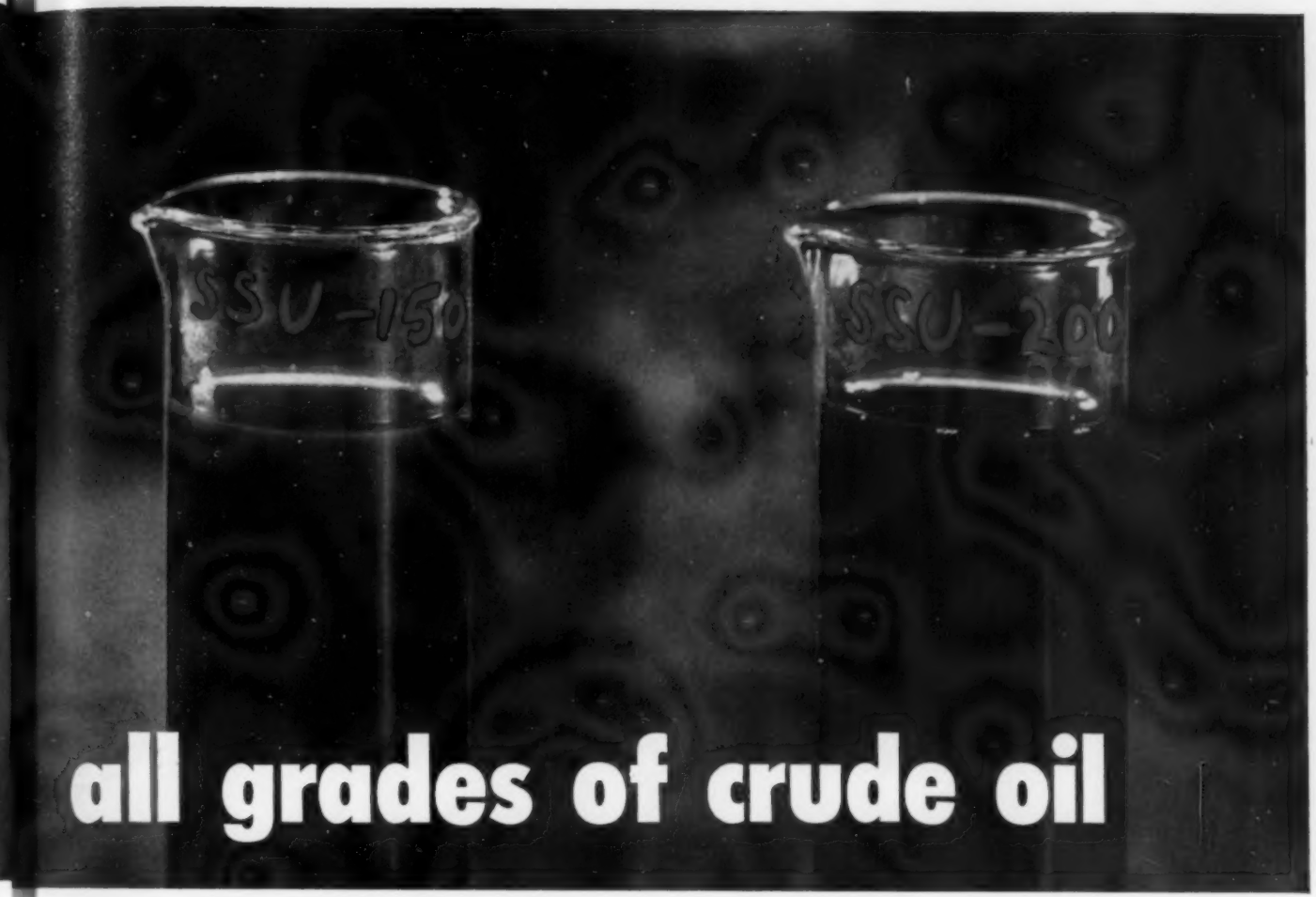
It's time to compare . . . with Link-Belt Speeder





Sectional View

ROCKWELL TURBO-METER

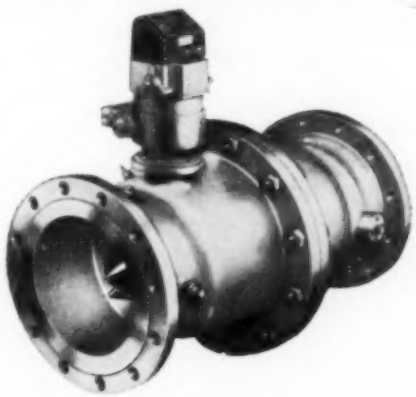


e all grades of crude oil

without recalibration?

ONLY ROCKWELL TURBO-METERS MEASURE BOTH THICK AND THIN LIQUIDS WITHOUT MANUAL ATTENTION

Product or temperature changes don't mean a thing to the accuracy of Rockwell Turbo-Meters. The same unattended meter will measure any hydrocarbon—from the heaviest crudes to light ends and piped products. A built-in viscosity compensator automatically makes the necessary corrections under continuous service conditions. All you do is read the meter. With optional remote registration you can even have "run" tickets from printing registers at your fingertips.

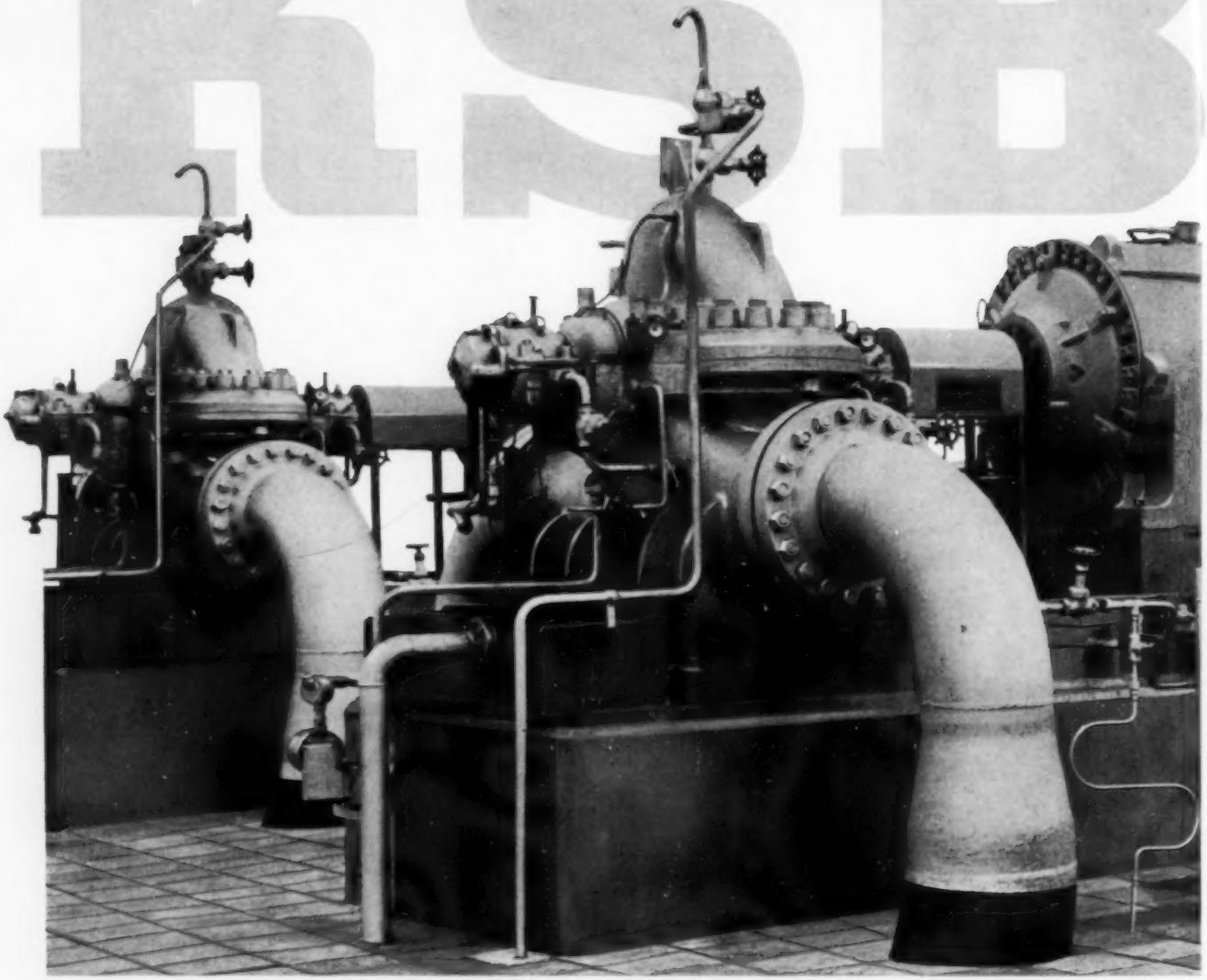


Another exclusive advantage is the wide range of flows that Turbo-Meters will measure with accuracy—all the way down to 20% of maximum capacity. For your convenience in checking their accuracy, provision is made for fast, in-line proving without interrupting the flow.

Before you buy any turbine type meter, get all the facts. See your Rockwell jobber or write us for bulletin PI-417. Rockwell Manufacturing Company, Dept. 125D Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Box 420, Guelph, Ontario.

TURBO-METERS
another fine product by
ROCKWELL

KSB



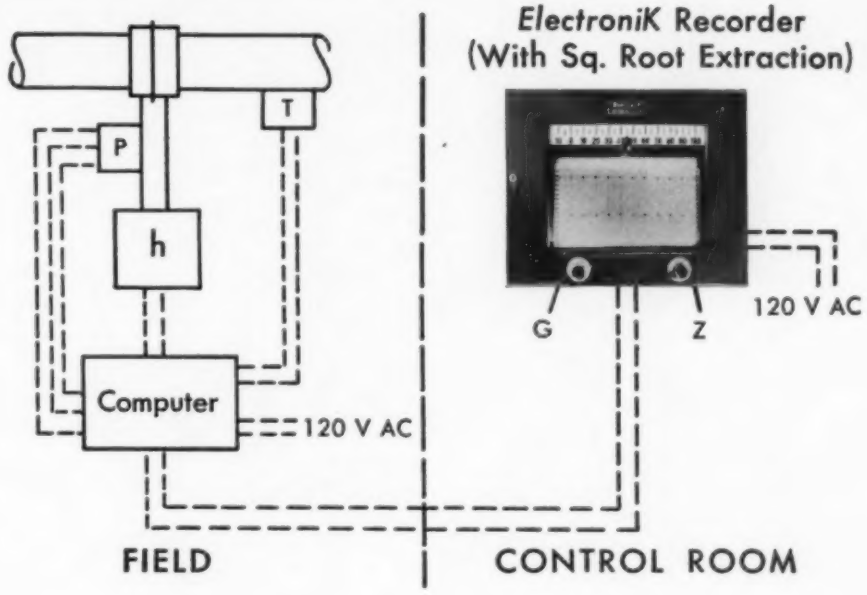
A 1794-1

KSB Pipeline Pumps designed on the basis of the latest experience with one or more stages to meet any of the usual operating conditions. The axially-split casing permits of the rotor being removed without disturbing the piping, which is connected to the lower half. The mechanical seal can be withdrawn withhout having to open the pump, since distance pieces in the coupling permit of axial movement of the shaft-seal elements towards the prime mover.

The sturdy construction and high-class workmanship of these pumps enable them to meet the most exacting service conditions.

KSB

Klein, Schanzlin & Becker Aktiengesellschaft, Frankenthal (Pfalz) Germany



New Honeywell all-electric Gas Flow Computer

measures and records mass flow rate automatically and continuously

Here's how the Honeywell gas flow computer solves a gas flow equation:

$$Q = K\sqrt{\frac{hP}{TGZ}}$$

Where **Q** = mass rate of flow, scfh
h = differential pressure, inches of water
P = static pressure, psia
T = flowing temperature, °R, (°F + 460)
G = specific gravity
Z = super-compressibility
K = orifice flow constant

The *ElectriK Tel-O-Set* △P/I transmitter measures *h*; an absolute pressure transducer measures *P*; and a resistance thermometer bulb measures *T*. The analog computer multiplies *h* by *P* and divides by *T* . . . and sends a resultant millivoltage to the *ElectroniK* recorder. The recorder applies the correction factors G and Z, extracts the square root, and records the resultant mass flow Q.

Easily linked to telemetering and remote control systems, supervisory control, data handling and industrial process computers.

No more tedious, time-consuming calculation of gas flow. This versatile gas flow computer does it for you . . . automatically, continuously. It measures and records gas flow in terms of standard cubic feet per unit time, and is the only all-electric system of its kind.

The Honeywell gas flow computer consists of an *ElectroniK* strip chart or circular chart recorder, a power supply, a standard resistance thermometer, an absolute pressure transducer, a voltage-divider type computing circuit, and an *ElectriK Tel-O-Set* differential pressure-to-current transmitter. The transmitters, transducers and computing circuitry can be mounted *near the orifice*, and only two wires bring the signal into the recorder in the control house. Field-mounted equipment available in explosion-proof housings.

There are many optional accessories. The recorder can be supplied with pneumatic or electric control, retransmitting slidewires, digital encoder, motor or servo-driven control index or pneumatic *Indexet*, hi-lo alarms, auxiliary contacts, pulse telemeter transmitter, and many other options.

Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell

First in Control

SINCE 1885

For more data on advertised products, use Readers' Service Cards, last page.

COMPLETELY SELF-CONTAINED ELECTRO-HYDRAULIC ACTUATOR FOR

Positive Control Where Pneumatic Supply Is Not Available

Fisher Type 350 control valve at a products pumping station in the Southwest.

● High performance without use of electronic amplification ● No close fitting parts ● Simple nozzle-flapper combination controls hydraulic pressure ● Maximum stem thrust of 5,000 pounds ● Can be used with many styles of valve bodies in sizes from ½" to 16" with strokes from ½" to 3". *Write for Fisher Bulletin E-350A for complete details.* Fisher Governor Company, Marshalltown, Iowa. Plants in Woodstock, Ont., Rochester, England. Butterfly Valve Division: Continental Equipment Co., Coraopolis, Pa.

TYPE 350

Exploded view showing arrangement of components on mounting plate. Every part except hydraulic cylinder and piston may be removed as one unit. For periodic maintenance entire unit may be replaced with stand-by assembly in minutes.

PERFORMANCE DATA—TYPE 350
(2,000 lb. thrust unit)*

Stroking Speed—0.37 in/sec
Stalled Stem Thrust—2,000 pounds
Linearity—Better than 2% of full travel
Resolution Sensitivity—Better than 0.05%

Load Sensitivity (Percent of total travel per 100 lbs. load)

Input Signal	Internal Resistance of Actuator	Load Sensitivity
1 to 5 ma DC	2,200 ohm	1.0%
1 to 5 ma DC	12,000 ohm	0.38%
4 to 20 ma DC	260 ohm	0.92%
10 to 50 ma DC	380 ohm	0.3%

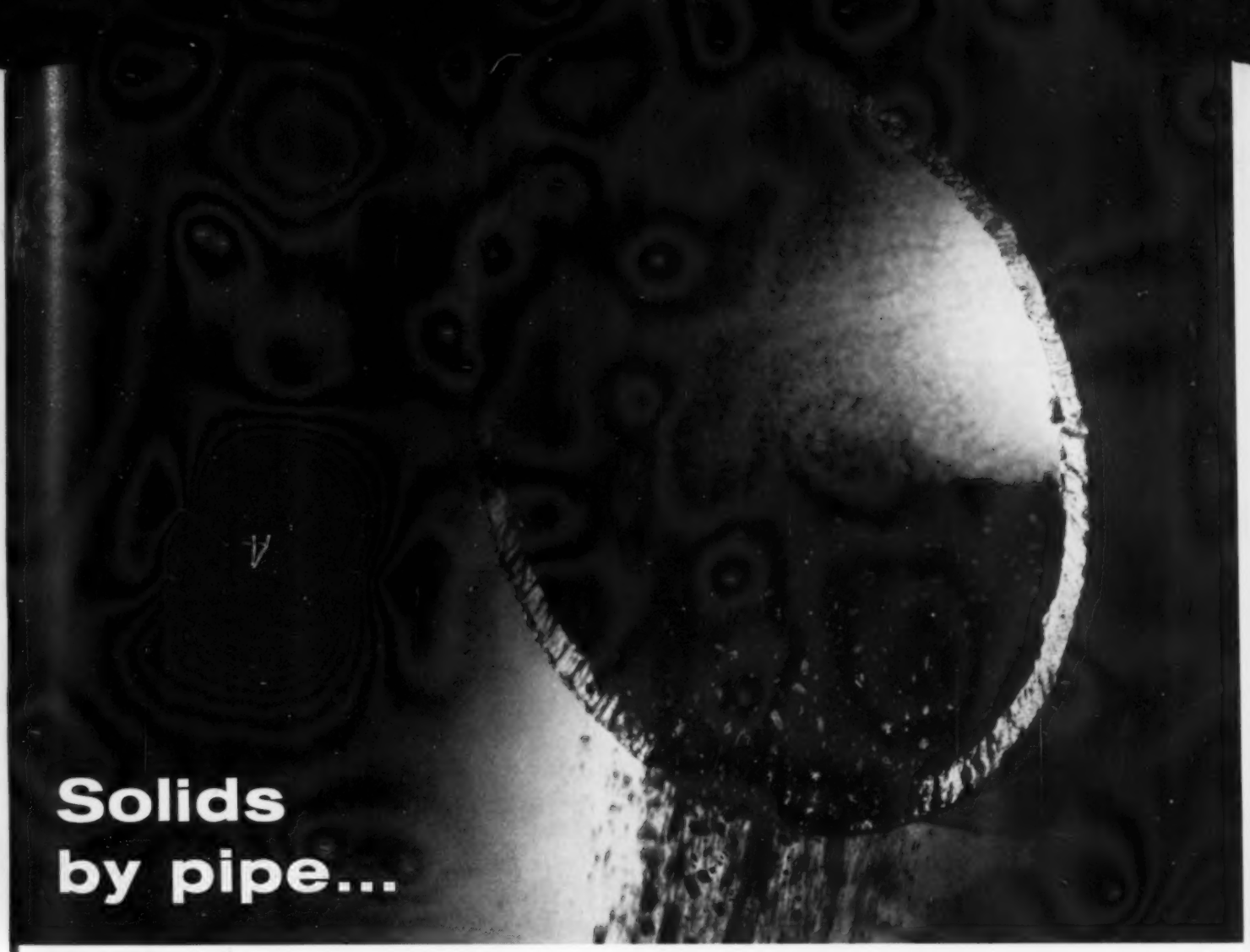
Frequency Response (Complete frequency response curves available)

Stem Travel	Cps at 90° Phase Shift
½"	1.9
1⅛"	1.5
3"	.8

*Also available with 5,000 lb. thrust unit.

If it flows through pipe anywhere in the world ...chances are it's controlled by.....

FISHER® Controls SINCE 1880



Can you meet the challenge of this new day in bulk transportation?

Will you be in the running when the pipeline industry's biggest new job starts taking shape?

Solids by pipeline is no longer a dream. It's a highly successful reality.

Gilsonite . . . coal . . . *what raw material will be next* to start moving to market through a pipe?

As you get set to meet the mighty challenge and opportunity that solids pipelining presents to your industry, remember this:

1. Men who engineer solids pipeline systems find that *uniform concentration* of solids is a must in a pipelined slurry.
2. You can get the slurry uniformity you want—with LIGHTNIN Mixers.

LIGHTNIN Side Entering Mixers keep 700 tons of solids per day uniformly suspended for dispatch through the pioneer American Gilsonite Co. pipeline. LIGHTNINs in thousands of chemical plants mix slurries of every kind, rapidly, dependably—*to the exact level of uniformity needed.* If it can be slurried, you can slurry it *uniformly* with LIGHTNINS.

If you'd like quick, competent help on slurry suspension for a specific project, call in your LIGHTNIN Mixer representative now. He's listed in Pipeline Composite Catalog. Or write us in confidence.

Good mixing helps move Gilsonite over a mountain

Solids pipeline built by American Gilsonite Co. makes the refining of gasoline from Gilsonite economically possible. It saves more than $4 per ton—a million dollars a year—over other methods of transporting Gilsonite ore over a mountain from mine to refinery.

American Gilsonite's 6-inch pipeline carries slurries averaging 38% solids and 62% water at 350 gallons per minute. It delivers more than 700 tons of solids per day at the downstream end, 80 miles from the eastern Utah mine.

Cut from the solid vein with high-pressure jets of water, the shattered ore is flumed more than a mile underground to the bottom of the 800-foot-deep central shaft.

Then the ore is screened to 8-mesh maximum, pumped to the surface with fluming water, and mixed to uniformity in 200,000-gallon holding tanks equipped with LIGHTNIN Side Entering Mixers.

Lightnin® Mixers MIXCO fluid mixing specialists

MIXING EQUIPMENT Co., Inc., 196-d Mt. Read Blvd., Rochester 3, N. Y.

In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Ave., Toronto 19, Ont.

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PIPE LINE PANORAMA

Technical Progress to Be Highlighted at API Meeting . . . Annual Pipe Line Conference of API Division of Transportation will convene in St. Louis, April 26-28. Papers will include:

Offshore Tanker Moorings, R. P. Howell, Standard Oil of California—describes and illustrates most common types of moorings now in use.

Underground Storage Operation, G. P. Jennings, Phillips Pipe Line—reviews experience of numerous companies in operation of the three types of underground caverns, giving comparative economics of each.

New Developments in Pipe Line Operations, Fred S. Jones, Platte Pipe Line Company—describes more significant innovations which have been applied to pipe line operations during past year, i.e., remotely controlled tank switching, hydraulic signal pressure control, alternate pressure telemetering, personnel development, the area maintainer, automatic welding.

Other papers include, "Expense Estimating and Forecasting for Operations as a Basis for Cost Control," C. R. Thompson, Magnolia Pipe Line Company; "Manning Today's Organization for Tomorrow's Operations," Jack A. Horner, Shell Pipe Line Corporation; "Today's Competitive Pipe Line Organization," A. J. Helmbrecht, Buckeye Pipe Line Company; "Transport Industry Organization," John E. Clayton, George Washington University.

Be sure to watch for your May API Issue of Pipe Line Industry. It will include the most complete report published on these highly informative API papers.

How to Improve Gas Pipe Lines . . . Results of eight years American Gas Association research to determine performance characteristics of steel pipe and to develop more practical pipe line design has been made public for the first time by Battelle Memorial Institute. Findings in brief:

Cleavage fractures. Experiments to determine fracture characteristics of line pipe at different temperatures make it possible to design against cleavage failures. Research also has made it possible to determine specific effects of chemical composition, grain size, finishing temperature and cold work on pipe properties—and steps to take in pipe manufacture to improve properties. Best way to prevent cleavage fractures is to find pipe defects early—and get them out. Battelle also studied environmental factors such as longitudinal stress, daily pressure fluctuations and temperature.

Girth welding. Experiments have defined causes and methods of controlling underbead cracking in girth welds, repair welding, etc. Three factors are instrumental in success of girth welding: steel composition—preheat and postheat—adequate welding electrodes.

Design of branch connection reinforcements. Major result of research during past year has been proposed new methods for specifying reinforcements that will be submitted to ASA B31.8 Committee for inclusion in Code. Experiments also point out deficiencies used in the past, so that adequate design can be worked out.

Effects of cyclic loads on branch connections. Research shows good alignment and fabrication procedures are instrumental in preventing fatigue cracks from occurring in compressor stations. A machine has been developed to subject branch connections to same cyclic loading as they receive in reciprocating compressor station. This is first machine to make tests on full-size specimens, and is providing AGA with valuable data on piping design against vibrations.

A SPECIAL REPORT — AUTOMATIC CONTROL AND COMMUNICATIONS

Developments to Watch in

By Donald M. Taylor, Engineering Editor
PIPE LINE INDUSTRY

ABOUT A YEAR AGO in a large southern city, three bright young men resigned their jobs with a large electronics firm to strike out on their own, hoping to turn their meager "shoe string" of financial backing into millions. They organized a company with the avowed intentions of making small computers and other electronic whatnots.

Next they incorporated, naming themselves officers of the virtually penniless corporation and hired a public relations firm to publicize their aspirations and potentials.

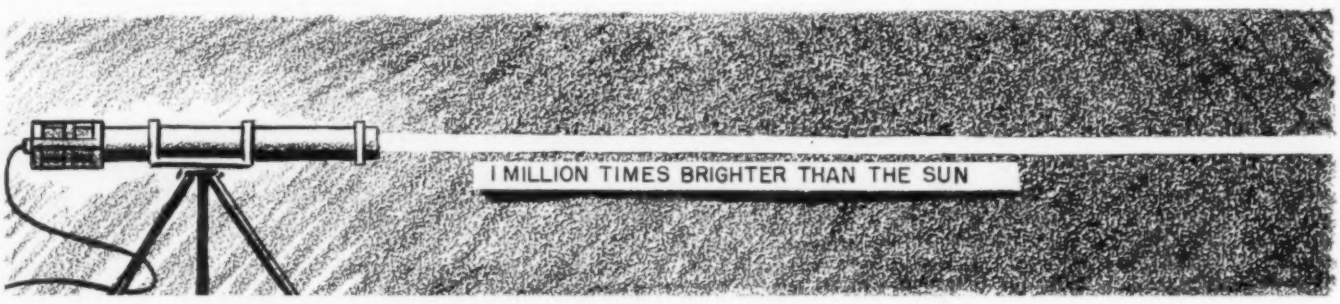
This brought them to the attention of an underwriter, and almost as quick as you could say, *"Ground floor . . . Bright young scientists . . . New type computer . . . and Government contract,"*—enough stock had been sold to net the trio $350,000 with which to launch their endeavors!

What does this prove? First, it shows that the electron is powerful indeed. It can turn a sow's ear of undercapitalization into a $350,000 silk purse for the simple reason that such ventures have been paying off in recent years.

Also, it shows that the public believes that electronic equipment will be the star of tomorrow's push button world, and there is plenty of justification for this belief. Just flip the yellow pages of most any city telephone directory to *"ELECTRONICS SUPPLIES—Manufacturers"* and you'll find dozens of brand new companies listed. Then look over the financial papers and you'll find that economists are predicting that yearly sales of microwave equipment will reach $2 billion by 1965. Too, you'll note that the government and industry sponsored research in electronics is following a steeply ascending curve; and exciting new developments of recent months have broken through to a no-limit ceiling.

How will this affect pipe lines? Actually, automatic controls as we know them today started with pipe lines (flow and pressure regulators) and pipeliners have always been quick to adapt new control and communications ideas to their operations. In fact, most pipe lines have made definite moves toward automation and remotely supervised operations. This trend is progressing.

As you read about the new ideas in communications and controls listed below, try to imagine their effect on pipe line operations.



MASERS and LASERS—exotic links to the future!

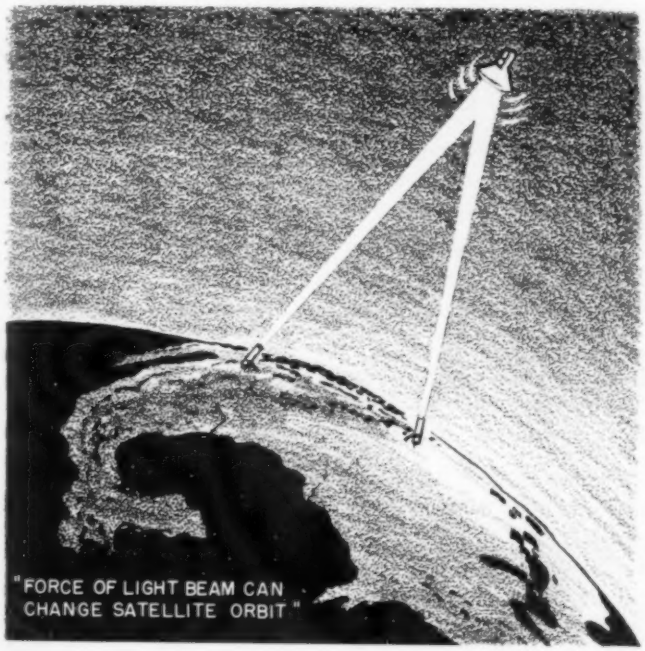
Not since the invention of the vacuum tube has there been a development in the field of electronics that can compare with the MASER.

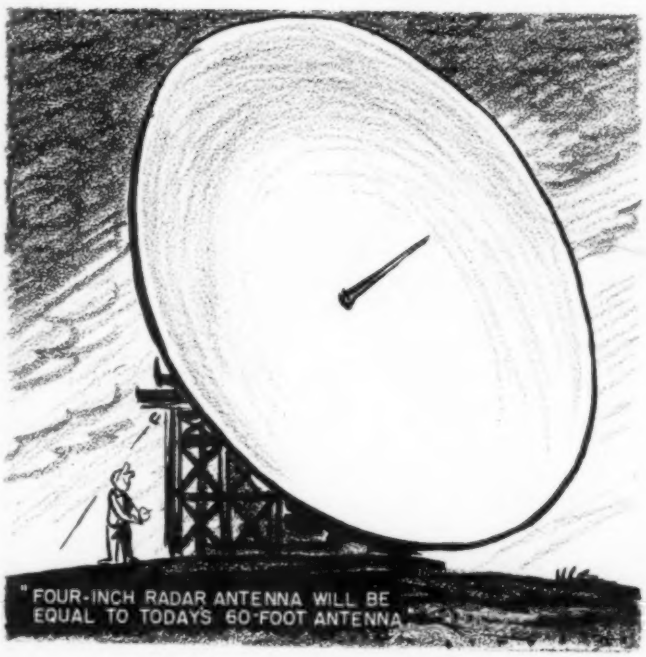
And like many other great advancements, it brings the power to destroy along with great promises of benefits to mankind.

The MASER can amplify radio and light waves to fantastic multiples, then emit them as concentrated and

Communications and Controls

Some of the things MASERS can do





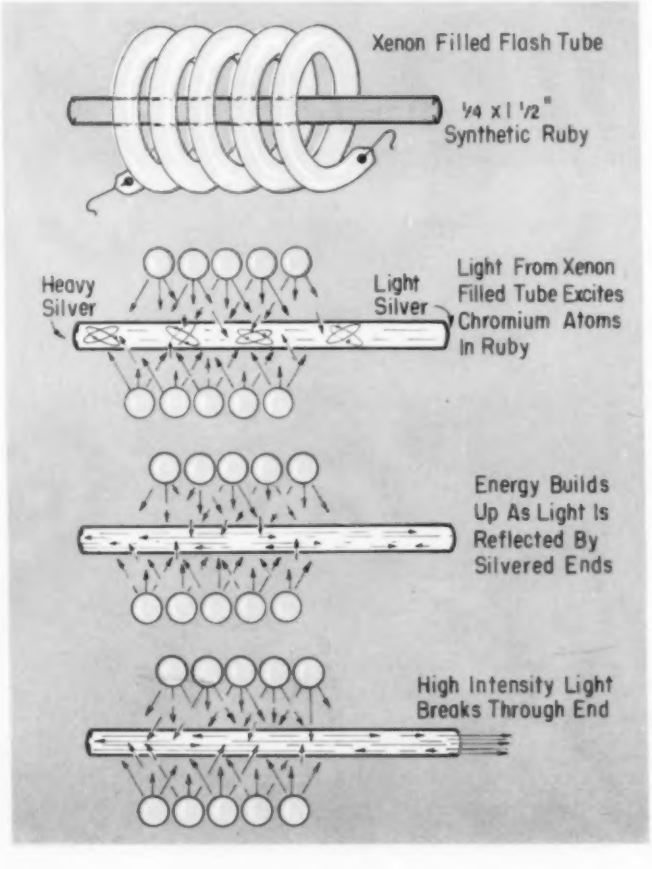
virtually parallel, beams. So great is the amplification, that scientists think that the *force* of such light waves will be sufficient to steer wayward satellites back on course even though the light sources are thousands of miles away from the space vehicle!

Because of its ability to amplify and concentrate monochromatic light, an Optical MASER (usually called LASER) could be turned into a first class *"death ray"*. Likely it would be considerably more lethal than those Flash Gordon and Buck Rogers have been toting around for the past 20 years. As a case in point, scientists in Bell Telephone Laboratories are using a MASER to produce a light beam of such intensity that it can vaporize a piece of carbon in about one millionth of a second, *and it takes a temperature of at least 7500° F to vaporize carbon!*

The intensity of light from an optical MASER is a million times brighter than the sun. To dwell a bit more on the destructive side, just imagine what would happen if MASERS were developed which could amplify X-rays and other harmful rays.

On the beneficial side, the MASER promises to relieve the congestion of our crowded radio spectrum. Scientists have estimated that we may have optical communications systems which will carry 10-million simultaneous TV channels on a single 1-A bandwidth. (See February 1961 PIPE LINE INDUSTRY, Page 60)

How a ruby MASER works


Xenon Filled Flash Tube
¼ x 1 ½"
Synthetic Ruby
Heavy Silver
Light Silver
Light From Xenon Filled Tube Excites Chromium Atoms In Ruby
Energy Builds Up As Light Is Reflected By Silvered Ends
High Intensity Light Breaks Through End

In addition, the MASER is bringing us greatly expanded electronics systems. Through its fantastic ability to amplify radio waves without distortion or noise, the device will make distances between transmitters and receivers of little consequence in the future.

Even the early model MASERS have proved highly effective in this regard. One of them, installed on a Navy radio telescope two years ago, extended the range of the installation three times as deep into space. MASERS also made it possible for the satellite Echo I to reflect meaningful signals back to earth. Bell scientists say they were able to pick up reflected signals which had a power of less than 1/100,000,000,000 of a watt!

So great is a MASER'S ability to amplify, that one scientist has estimated a radar system with one of the devices as a component, will be able to achieve the same quality with a four-inch-diameter antenna as an ordinary system can with an antenna 60 feet in diameter!

Before we go into the great possibilities offered by MASERS and LASERS for pipe lines, let's briefly run through the steps in their development. Strictly speaking, the MASER stems from discoveries made early this century by Alfred Einstein and German physicist, Max Planck. They found that some atoms have more energy than others; and that, under certain circumstances, low-energy atoms could absorb energy from outside signals to become high-energy atoms.

Later when the U.S. Navy asked Columbia University physicist Dr. Charles Townes to find some means of extending the range of microwave, he decided Einstein and Planck's concept would be a likely approach. He reasoned that if he could cause high energy atoms to vibrate at a certain frequency, then impress a microwave signal of the same frequency on them, the energy given off by the atoms would reinforce the strength of the microwave signal.

This method succeeded in 1954 when Townes fired microwave signals into a tube of amonia gas (which is known to contain high-energy atoms). The microwave signals were greatly amplified, and Townes had made what will probably prove to be one of the greatest discoveries of this century. He named his discovery MASER as an abbreviation for Microwave Amplification by Stimulated Emission of Radiation.

Many companies immediately became intrigued with the device and set out to improve it and extend its range. One important step came when Hughes Aircraft Research scientists invented a synthetic ruby crystal which could amplify light. This device is called an Optical MASER or a LASER (Light Amplification by Stimulated Emission of Radiation.) It absorbs light energy over a broad band of frequencies, then radiates the energy in a very narrow band of frequency. The emitted light is monochromatic and duplicating its intensity with conventional light sources would require temperatures of several billion degrees. The main limitation of the ruby MASER is that it emits light in pulses which come as its chromium atoms alternately build up energy

levels and then discharge the energy to once again become low-energy atoms.

Recently there have been two new developments in this field. IBM Research has announced a new MASER composed of calcium fluoride crystals adulterated with one percent uranium or samarium ions. These crystals produce a continuous signal of monochromatic light a million times brighter than the sun. The cone of the emitted light has a spread of only 1/20 of a degree and it can be focused to a diameter of 15 to 30 millionths of an inch.

Just last month, Bell Laboratories announced the development of a gas MASER. (See March, 1961 PIPE LINE INDUSTRY, page 58) Using 40-watt radio frequency to excite a mixture of helium and neon in a tube, Bell scientists have produced a MASER which emits a continuous infrared light at five different wave lengths between 11,000 and 12,000 Angstroms. It can be focused through a hole 50 millionths of an inch in diameter.

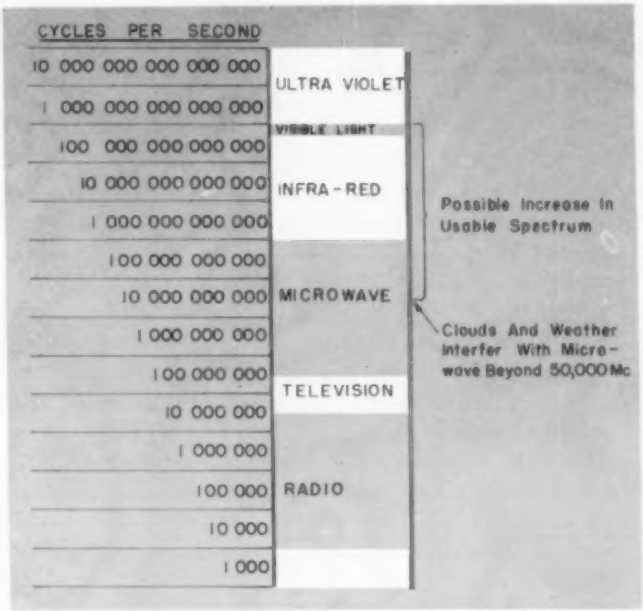
The possibility of using such a concentration of heat for surgery is being investigated by several research groups. Technical Research Group, Inc., used a MASER to burn off tumors on the retinas of the back of rabbits' eyeballs. For the final concentration of the beam, they used the lens in the rabbits' eyes. This keeps the front part of the eye from burning. This device has many uses for human beings, and such instruments will be marketed starting this month.

How will such devices affect pipe lines in the future? Most likely the effects will be felt in two ways. First, communications will be improved to such a degree that systems will have unlimited capabilities. This means automation and remote supervision can be carried out to almost any desired degree.

But for most pipeliners there is a still more important aspect of the MASERS. Most likely, many of the cross-country communication channels we will install in the future will be based on Optical MASERS and to prevent attenuation of signal strength, pipe lines may be used as carriers. Some of the lines would have to be laid to a line-of-sight profile, and possibly exhausted to near vacuum for best results. Other wave guides can be laid to contour of the right of way.

There is a possibility that one day most energy will be transported via pipe lines containing nothing but high intensity light!

Low noise amplifiers (including MASERS) will extend communication range through infrared



Ultra low noise amplifiers will take the limit off range and frequencies

As it stands today, our radio spectrum is crowded—yet there is plenty of spectrum left beyond 50,000 mc (see illustration top right) generally regarded as the upper limit for microwave. The only trouble is that as the frequencies increase on toward visible and ultraviolet light, the effects of clouds, fog etc. are greater. This tendency is felt keenly in the upper range of microwave frequencies.

The main limiting factor, however, has not been the fog, rain or clouds—for with sufficient amplification in a receiver, these deleterious effects would be of no consequence. The big limiting factor has been amplification. For each stage of amplification produces its very own circuit noise, and as the number of stages is increased, the noise build-up increases and after a certain number of amplifications, the noise exceeds the signal.

In electronics, amplification starts with a faint incoming signal which imparts its own characteristics to a stronger current; then the stronger current similarly modifies an even stronger current and so on until a sufficient current with the characteristics of the original signal can power the speaker, etc.

Stanford Research Institute recently took a long stride in overcoming the foibles of amplification by developing a single diode, low-noise amplifier which is simple, sturdy and has wide frequency bandwidths. By using circuits

employing several such diodes, Stanford scientists have extended the frequencies to almost any desirable range.

Here's the way the new method of amplification works. Amplification energy is introduced into the circuit twice per cycle in much the same manner as a child pumps a swing each time it passes through the zero position. This is accomplished by applying a voltage at twice the frequency to a diode capacitor. The resulting noise level is far below present-day circuits.

This same effect may likely be obtained by varying the magnetization of a ferrimagnetic pumping element instead of varying the capacitance of the diode.

New diode bows in: "will mean new era in communications," says scientist

"We are on the threshold of a new era in communications as a result of recent breakthroughs in microwave technology," says Dr. Alan M. Glover, RCA scientist, describing a new class of diodes called, "veractors," because they act as variable capacitors in electronic circuits.

The new solid state components are worth their weight in diamonds—they're smaller and lighter than buckshot and sell for $200 to $700 depending on the level of their frequency response.

What will be their effect on communications? Dr. Glover thinks the new diodes are a significant step towards the day when high frequency bands will be used to multiply many-fold the total amount of traffic that can be carried.

The new diode is one of seven types, announced by the company, that operate within a frequency range from 2,000 to 20,000 megacycles. They are so sensitive they will pick up and amplify microwave signals transmitted at frequencies close to those of infrared light!

When operating in an electronic circuit the veractor diodes take a microwave signal coming in and kick it to a higher energy level by phasing in a "pump" signal generated by another source within the circuit. The original signal is thus amplified until it is sufficiently strong to activate equipment such as a speaker, radar scope or computer.

The new devices are made of a high-temperature material known as gallium arsenide.

Finding path length for tropospheric scatter circuits

The National Bureau of Standards has been carrying out research on tropospheric scatter circuits. Recent developments in phase measuring techniques of signals propogated through the atmosphere has led to a system which should enable us to make accurate determination of the physical radio path in a beyond-the-horizon transmission. An accurate measure of this length will determine the actual location of that portion of the scattering volume which plays a role in this phenomenon.

Miniaturization in electronics and its purpose

Last July, PIPE LINE INDUSTRY carried a short article describing a technique developed at Stanford Research Institute which makes it possible to "machine" 100-million electronic components and proper interconnections on one square inch of a sandwich made of metal conductor, insulator film, etc.!

The purpose of this technique, which utilizes low energy electron beams to effect chemical and physical changes, is to form integral parts of a super computer which will rival a human brain in thinking ability—yet have a speed 10 million times greater. To accomplish this, the switching time of computer components must approximate one ten-billionth of a second!

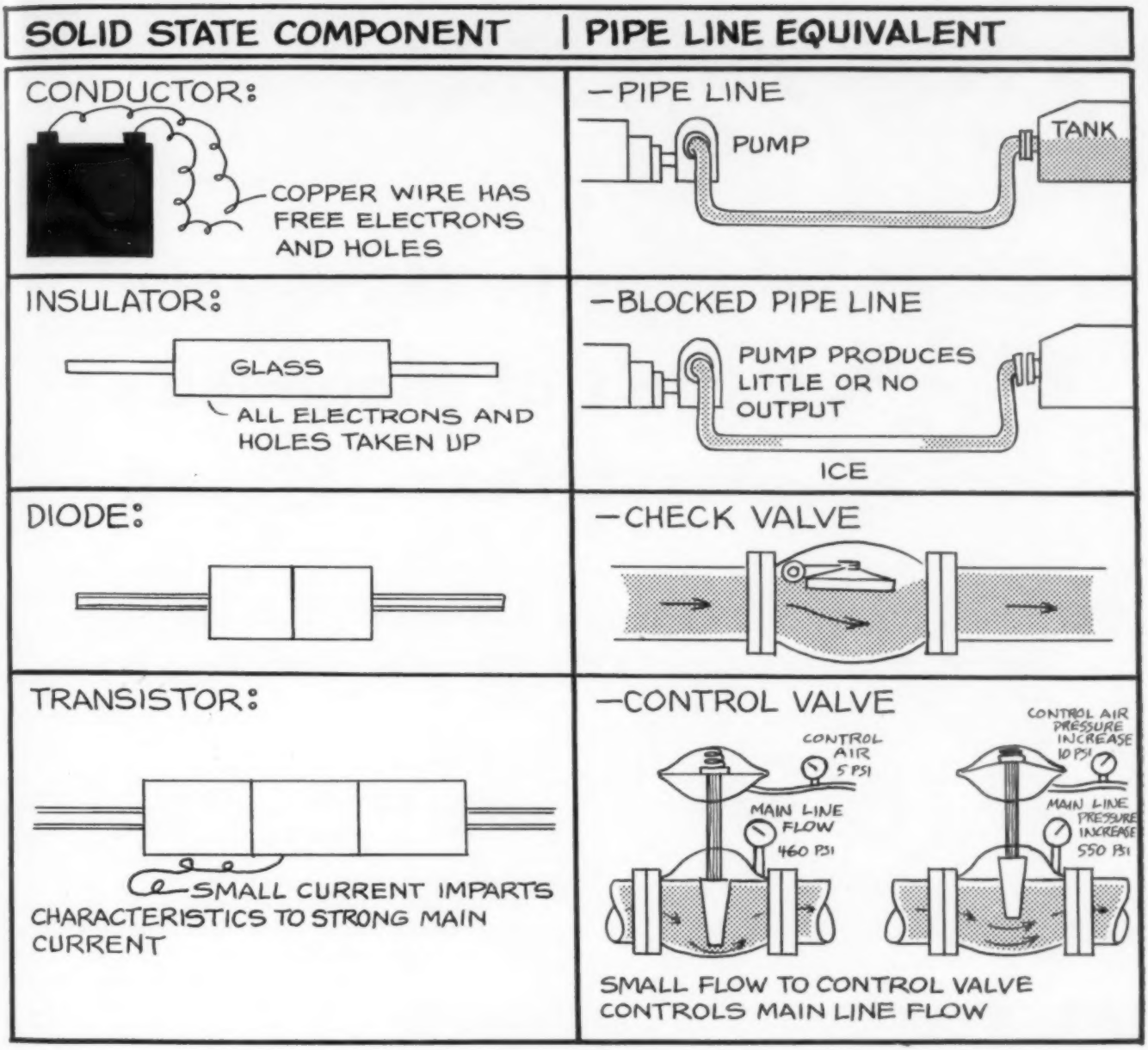
Thus urge for speed, coupled with a desire for circuit quality, is typical of research in electronics today; and it is leading us further into the realm of solid state physics and miniaturization of circuit components.

Just what do we mean by solid state electronics? For one thing, all components are solid. Some of them are conductors, some are insulators and still others are semi-conductors, but none of them depend on air gaps etc. for current modification.

In terms of the pipe line:

- A conductor is like a pipe line filled with crude or products. Pump into one end, and fluid comes out the other.
- An insulator is like a pipe line frozen solid. Even extreme pumping does not cause appreciable flow.
- A semi-conductor is like a valve—sometimes it permits flow at other times it prohibits it.

It is the semi-conductors that make modern-day electronics possible. Generally, they are divided into two



classes—the diodes and the transistors. In terms of the pipe line, a diode is a check valve. It permits flow only in one direction. For example, when an electrical current flow is alternating in direction (AC) the diode lets it go through in only one direction; in other words, it rectifies the current.

A transistor is like a control valve. Vary the air input to the diaphragm, and you can vary the flow in the main stream.

Most semi-conductors are made of silicon or germanium, which in their pure state are insulators. But when they are adulterated with small amounts of boron or arsenic, they become semi-conductors.

One of the big fields for advancement in electronics has to do with growing crystals. Scientists say that our transistors and diodes of today are crude in comparison with the sophisticated versions expected in the future. Actually, they are needlessly large and contain too much impurity, scattered in the crystal without proper placement. One day in the future we may have single minute crystals which will perform the functions of thousands of transistors as we know them today.

In July 1959 PIPE LINE INDUSTRY described micro circuitry of such minute dimensions, that if all the electronic circuitry in the entire United States were similarily miniaturized, it would fit into a one-cubic-foot box!

We are making great progress toward such miniaturization, and this progress will lead us to computers of fantastic capabilities. Today, even the finest of our computers are basically idiots. A computer will do exactly what the programer orders—even if the instructions are totally stupid. But in the future we will have computers which can duplicate our thinking. They will be able, for instance, to arrive at valid conclusions from incomplete data—just as we are able to do.

This will bring us truly automatic pipe lines if we want them. Moreover, they will be operated at an efficiency far beyond our human capabilities! **—The End**

A SPECIAL REPORT — AUTOMATIC CONTROL AND COMMUNICATIONS

New Ideas in Microwave Spark Design of Magnolia's West Texas System

Concrete building that may thwart hunter's random firing; new bilateral switching and fault sensing equipment

By Richard L. Luthans
Motorola Communications and Electronics, Inc., Dallas

SEVERAL NEW IDEAS were incorporated in the design of Magnolia Pipe Line Company's microwave system being completed between Midland and Corsicana, Texas. The 13 new stations conform to new standards for intermodulation distortion—when all 90 channels are loaded, the flat signal-to-noise ratio in the worst channel shall be no less than 51 decibels. Magnolia specified duplicate standby equipment throughout the system with fault sensing equipment which can make a decision to switch to or from standby equipment in 800 milliseconds. The bilateral switching takes 55 milliseconds.

Another innovation is the concrete buildings which offer added resistance to random bullets from hunter's rifles and added insulation from the hot summer sun.

MONOLITHIC CONCRETE BUILDING offers added protection against the random firing of hunters and target shooters. In addition, the concrete provides good insulation against the hot Texas sun in summertime.

Magnolia Pipe Line Company transports crude oil and LPG from West Texas via three separate lines to Corsicana, a distance of about 350 miles. At Corsicana the pipe line system converges with another Magnolia crude line from Oklahoma and with other lines to the Mobil refinery at Beaumont. The first phase of the integrated microwave system was completed in 1959. It is comprised of 12 stations interconnecting Corsicana and the Beaumont refinery with the three intermediate pump stations and Magnolia's Dallas headquarters.

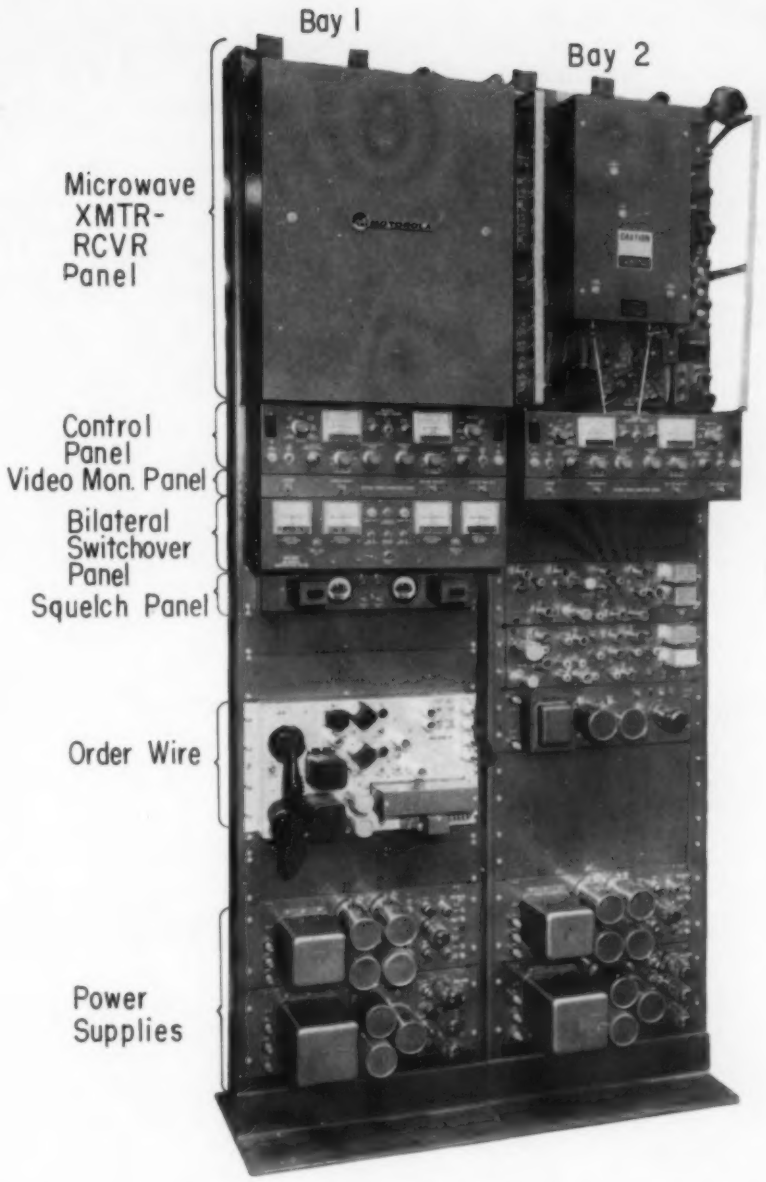
The 13 new stations now nearing completion will interconnect Magnolia's Midland terminal and Corsicana with six intermediate pump stations. At Corsicana most of the communications channels will be transferred to the "phase one microwave system for termination at Dallas".

The West Texas microwave system

including electronic equipment, buildings, towers and emergency power units is being constructed on a turn-key contract as was the Corsicana-Beaumont system. Magnolia furnished the contractor with detailed specifications and drawings for both systems, made the path survey and furnished accurate profiles.

Planned Reliability and Performance. The December ice and snow storms in West Texas were the worst in several years and hampered communications over Magnolia's wire lines which parallel the route of the microwave system. This pointed up the importance of "planned reliability" for the new microwave communications system.

System performance may be described analytically by the ratio of signal-to-noise level on the communications channel. Reliability may be defined as the percentage of time during which the communications channel signal-to-noise ratio exceeds a certain value: The Magnolia system is designed so that the 90 voice channels between Midland and Corsicana will have a signal-to-noise ratio in the worst derived channel of 45 db or better measured with a flat weighting filter (flat from 300 to 3,000 cps). To achieve a propagation reliability of better than 99.8 percent on each path during the worst month of the year, a fade margin of 30 db has been specified for each microwave path. With a 30 db fade on any microwave path, the signal-to-noise ratio on any derived channel shall not fall below 30 db with flat weighting.



BILATERAL SWITCHOVER is incorporated in this microwave terminal station. The switching takes about 55 milliseconds and it can work in either direction. Fault sensing equipment takes about 800 milliseconds to make a decision to switch.

"Slot-Noise" Testing. Probably the microwave system parameter that best defines the information carrying capacity of the system (other than bandwidth) is the intermodulation distortion produced by the RF system. This type of distortion results in the generation of spurious signals due to mixing of the wanted or authentic signals being transmitted. The spurious signals show up either in the form of intelligible crosstalk or unintelligible noise on the channels.

To effectively test the microwave intermodulation characteristic, Magnolia specified a baseband "slot-noise" test to be performed on the microwave system. Slot-noise testing is carried out by injecting a broad band of noise into the microwave system at a level which will simulate the maximum number of communications channels for which the system was designed. The injected noise is "notched" out at the input by several narrow band (approximately 3 kc) filters having very steep skirt selectivity. At the receiving end the noise in these quiet slots is measured. This noise will be the result of intermodulation products caused by the inherent intermodulation distortion characteristic of the system.

For the Magnolia system this test is being conducted in accordance with Electronic Industries Association standards proposal Number 647. End-to-end tests are to be made in both directions between Corsicana and Midland. With simulated loading for 90 voice channels, the flat signal-to-noise ratio in the worst channel shall be no less than 51 db.

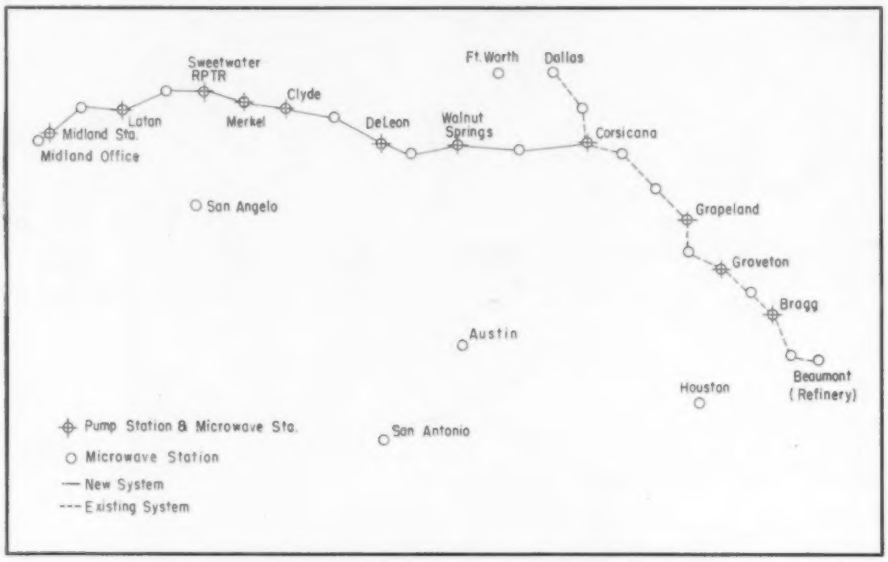
Bilateral Switchover for Microwave Equipment. To assure the maximum dependability, Magnolia specified 100 percent standby equipment with automatic switchover for all microwave electronic equipment common to all channels, including associated power supplies.

It would be possible to maintain this standby equipment in a de-ener-

gized condition when not in use; but if the main equipment failed, this would result in a communication outage of several minutes while the standby equipment warmed up.

Running the standby equipment hot not only reduces the switching interval but improves the long term operating stability of the system. Switching time is less than 55 milliseconds after a fault has been detected.

Magnolia has taken advantage of the latest developments in standby equipment design to specify *bilateral switchover*. In bilateral operation duplicate equipment is provided, each of which is continuously energized and each of which is continuously sensed for faulty operation. The duplicate equipment, designated Bay 1 and Bay 2, operates in such a manner that only one bay (the operating bay) is electrically connected to the antenna. Bilateral switchover allows either equipment to act as standby for the other and is capable of switching back and forth between equipments an indefinite number of times during unattended operation.



SYSTEM MAP. Magnolia's Dallas to Beaumont system was constructed in 1959. The new system, shown in solid line, has 13 stations with an average of 28.5 miles between stations. Towers average 282 feet in height and their cost ran about $290 per mile.

MICROWAVE EQUIPMENT ROOM AT CORSICANA. Voice and remote control multiplexing equipment is at left; four bays at right are microwave RF terminals (main and standby for east and west directions). Shown here is W. G. McLarry, of Magnolia's Communications Department.

Bilateral operation differs from "hot standby" operation in that in bilateral operation the direction of switching is continuously reversible and both equipments are sensed for faults. Whereas, in hot standby operation the switching is in one direction only (non-reversible) and often only the "main" equipment is sensed for failures.

The chief advantage of bilateral operation is that it is unnecessary for a maintenance man to make a special trip to the station to manually reset or switch back to main when a switchover has occurred due to a momentary failure or transient condition in the operating equipment. Hot standby equipment is very likely to switch over on momentary faults or transients.

The reason for this is that the time for the fault sensing equipment to reach a decision as to whether or not a fault exists has been reduced to a bare minimum in order to accomplish the principal purpose of hot standby which is to reduce channel outage time between failure of the operating equipment and restoration of service via the standby equipment. Naturally, as the time allotted for the fault sensing circuitry to make a decision is reduced, the chances of error in the decision are increased. In fact, if the fault sensing (decision) time were reduced to zero, the equipment would be as likely to switch to standby as not, even though no fault would exist. In the Magnolia system the decision making time has been optimized at 800 milliseconds. The switchover to the alternate equipment is completed within 55 milliseconds after the "fault decision" is made.

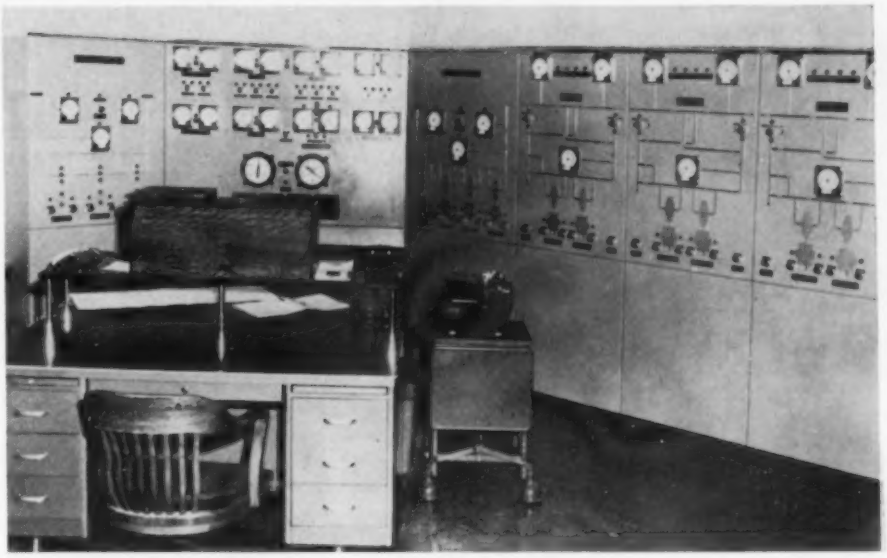
Of course, another reliability advantage is achieved from the fact that

both equipments are continuously sensed for faults. In a typical unilateral switchover system only the main equipment is fault sensed. Thus, a failure in the standby equipment can go undetected until the critical moment when the main equipment fails and the system switches to a dead unit!

Reserve IF Gain. It is generally conceded that the principal factor influencing the reliability of electronic systems is the electron tube itself. Thus, an improvement in system reliability would follow if the number of vacuum tubes in the system were reduced. However, in a typical microwave system the opposite is true. This paradox is explained by the fact that a typical microwave system consists of many electronic amplifier chains effectively connected in tandem over the many hops in the system. In Magnolia's system there are 15 hops on the circuits between the offices at Midland and Dallas. These amplifier chains amplify both IF (approximately 75 Mc.) and video (0-3 Mc.) frequencies. The system noise is contributed by each of these amplifier chains.

In Magnolia's system the circuits between the offices at Midland and Dallas travel over 15 tandem paths. Thus, the performance of each individual path must be maintained at a consistently high level in order to maintain good overall system performance.

It is not electon tube burn outs which create the problem, but rather long term gain degradation of the tubes. Circuits designed with a minimum number of tubes will begin yielding continually degrading performance almost from the time they are put into service. This means a steady stream of maintenance calls for adjustments and a steady stream of tube replacements. The video circuits can be conveniently designed with high gain and high inverse feedback to maintain long term gain stability. Similarly, it is most important that the microwave FM receiver have sufficient reserve gain to operate with full noise limiting long after the gain of the electron tubes has begun its gradual decline. Approximately 35 db of reserve gain is available in the 12 tube IF amplifier utilized on Magnolia's microwave system. Since the output level of an FM receiver is independent of the input level so long as the receiver is limiting effectively, the baseband gain stability is enhanced considerably with a large IF gain reserve.



REMOTE CONTROL PANEL AT CORSICANA. Three panels at right control pump stations via microwave.

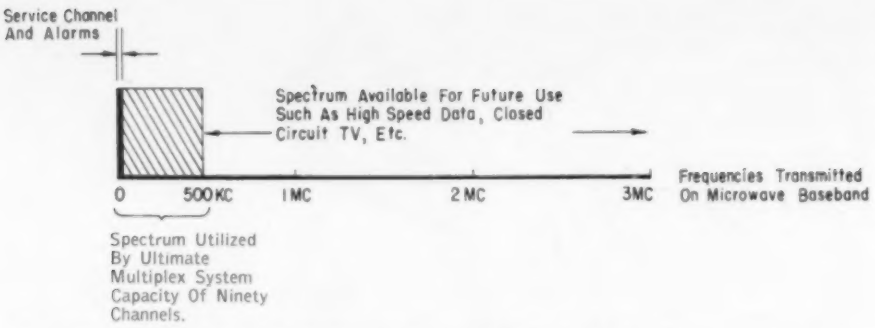
Were it not for this reserve gain, any degradation in gain of the IF amplifier would drop the output video signal level from the receiver. This in turn would drop the voice levels on all of the telephone circuits which are derived from single sideband multiplex.

The large IF gain reserve requires special fault sensing techniques on systems incorporating standby microwave equipment however. A fault is detected in the microwave receiver by passing a special sensing signal through the receiver and detecting its presence at the receiver output. When the sensing signal disappears, the system switches to the standby receiver. With the heavy reserve IF gain used in the Magnolia system, a failure of any of the first eight IF amplifier stages has such a small effect on the output level that it will not even produce a sufficient drop in the sensing signal level to have the fault detected by the sensing receiver. To facilitate detection of tube failure, silicon diodes are placed in the cathode circuits of the IF tubes in such a manner that when the tube fails to conduct, the sensing diode will conduct and kill the sensing signal which will initiate the switchover.

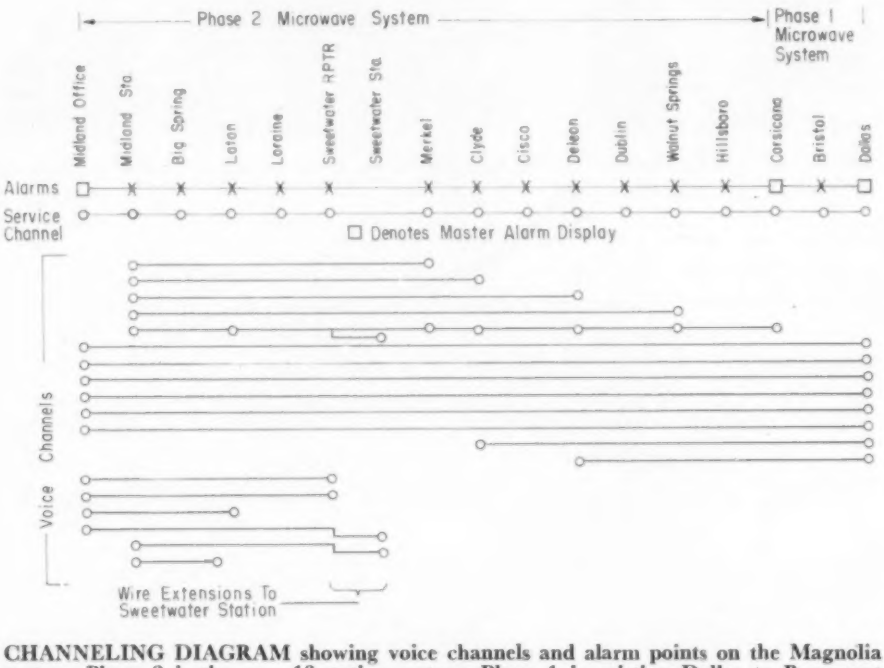
Independent East-West Switchover. At a microwave repeater station the microwave signal is received, demodulated and patched into a microwave transmitter for retransmission to the next station. In the Magnolia system the fault sensing system is able to detect and switch each side of the repeater station independently. Thus, if a failure should occur in the east receiver, only the east half of the station will switch over. If a fault occurs later in the west transmitter, then the west half of the station will switch over. This system offers considerably more standby protection than a fault sensing system which switches the entire repeater station upon the occurrence of a single fault.

Fault Alarm System. Should a malfunction occur at any station, an alarm is automatically transmitted from that station to the three alarm centers at Midland, Corsicana and Dallas. Dallas also receives alarms from the earlier microwave system to Beaumont. The following alarms are transmitted from each station:

1. Failure of one or more side lights.
2. Failure of one or both top tower lights or flashing beacons.
3. Any failure of the microwave RF equipment.
4. Commercial AC power failure.
5. Emergency power unit over-cranking alarm (unit fails to start).


Service Channel And Alarms
Spectrum Available For Future Use Such As High Speed Data, Closed Circuit TV, Etc.
Frequencies Transmitted On Microwave Baseband
0
500KC
1MC
2MC
3MC
Spectrum Utilized By Ultimate Multiplex System Capacity Of Ninety Channels.

MICROWAVE BASEBAND FREQUENCY SPECTRUM indicating reserve information carrying capacity for future system requirements of the Magnolia system.



CHANNELING DIAGRAM showing voice channels and alarm points on the Magnolia system. Phase 2 is the new 13-station system; Phase 1 is existing Dallas to Beaumont system.

Communications Channels. Voice channels for this system are derived by means of single sideband suppressed carrier multiplexing equipment having an ultimate capacity of 90 channels. Initially 19 voice channels will be equipped.

A separate service channel unit is installed at each microwave station for providing maintenance communications among all stations.

Towers. Triangular, steel, guyed towers are being used throughout the system. As part of the "planned reliability" for the system, Magnolia has specified that towers when fully loaded shall be designed for a wind pressure of not less than 40 pounds per square foot on flat surfaces. This includes all antennas and transmission lines installed on each tower in accordance with Electronic Industries Association Standard RS 222. Tower lighting utilizes photo-electric control and a load balancing resistor for the flashing beacons to maintain a constant load on the emergency power generator.

For the benefit of microwave system planners, the following tower statistics might be helpful:

Average RF path length (for 12 paths):	28.5 mi.
Average tower height:	282 ft.
Tower height per mile:	10.7 ft.

For the Phase One system (Dallas to Beaumont):

Average RF path length (for 11 paths):	24.1 mi.
Average tower height:	238 ft.
Tower height per mile:	10.8 ft.

Utilizing typical microwave tower costs of $27.00 per foot, one can conclude that tower expense will come to about $290.00 per mile, at least in typical Texas terrain.

Emergency Power Units. Each microwave station is equipped with a 3.5 KW or a 5.0 KW engine generator with automatic start and line transfer in the event of a primary power failure from the commercial AC mains. When commercial power is restored, the station is automatically transferred back to the commercial power system. Fuel is LPG provided by a 250-gallon outside storage tank.

Buildings. Reinforced concrete buildings are being provided throughout the system. There are two separate rooms in each building, an emergency power room of about 6½ feet x 11 feet and an equipment room of about 11 feet x 12 feet. Outside dimensions of the buildings are about 12 feet x 20 feet.

There are two advantages to the buildings. First, they offer additional resistance to random bullets and shots fired by hunters and target shooters. Also, they provide an added measure of protection against the heat of the hot Texas sun in summer. The white reflective paint also helps.

When this new microwave system goes in operation, it should be one of the world's most efficient communications systems. The careful planning in design and many improvements in equipment should give it an unprecedented reliability. —**The End**

About the Author

Richard L. Luthans is microwave sales representative for Motorola Communications and Electronics, Inc. He has been with Motorola for 9 of the 11 years that have elapsed since his graduation from the University of Illinois with a B.S. degree in electrical engineering. He was with Collins Radio Co. as systems engineer for microwave and scatter communications in 1956 and 57. Luthans served two years as a U.S. Navy submarine electronics technician.

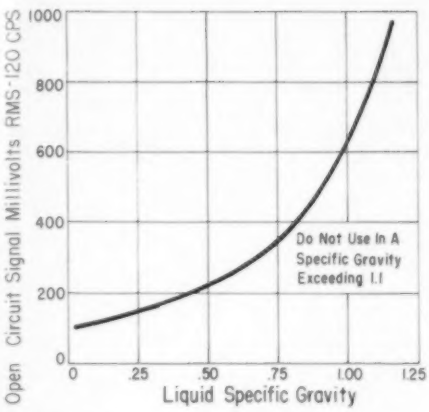


FIGURE 1—This is a typical output curve of the instrument used in batch point detection of crude.

Humble Reports on Improved Methods of Batch Detection

Two recently installed instruments pinpoint interfaces

By Ray Pfrehm
Supervising Engineer
Research and Development
Humble Pipe Line Company
Houston

TWO RECENTLY INSTALLED instruments presenting different approaches to batch point detection produced significant results in field and laboratory tests performed by Humble Pipe Line Company in recent months. Both instruments are sensitive to changes in specific gravity although each a somewhat similar principle of operation.

One of the instruments detects the changes in the specific gravity of a minute side stream which flows through a hollow tuning fork. The variation in mass of the liquid causes a variation in the mass of the prongs of the constantly vibrating fork, thus changing their fundamental frequency. Variations in frequency are correlated with values of specific gravity.

The second instrument also de-

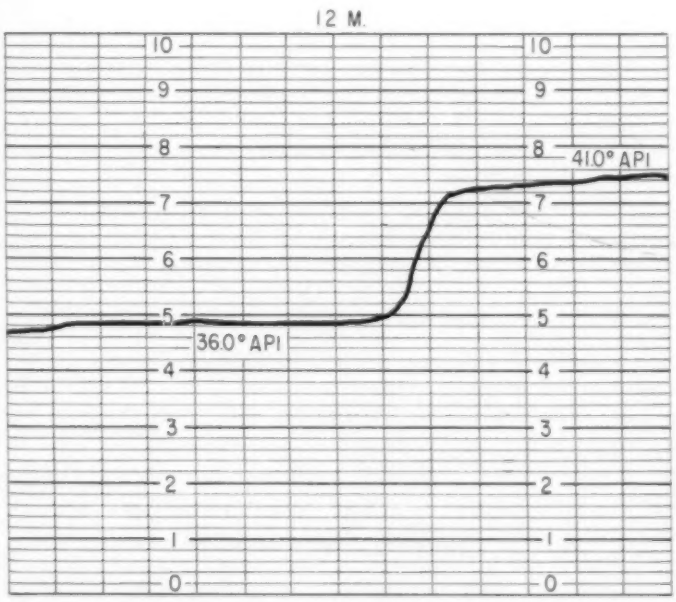


FIGURE 2—Chart shows low sensitivity setting with a clean interface. Crude at 41.0° is followed by crude at 36.0° API.

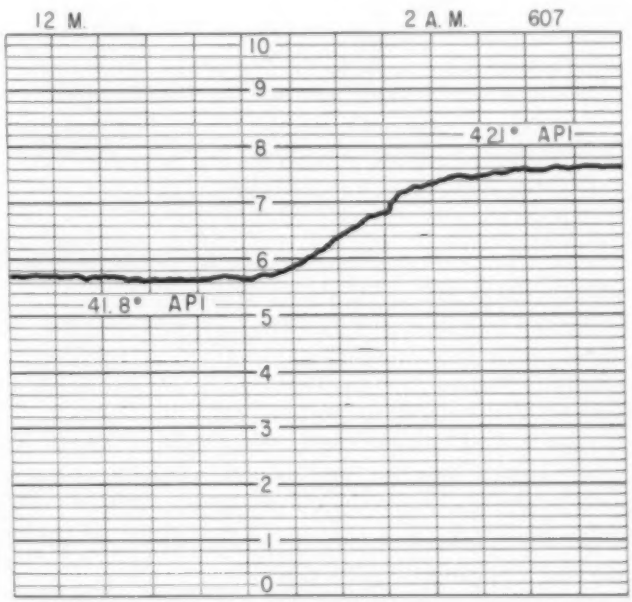


FIGURE 3—Chart records instrument's high sensitivity with a long interface as crude at 42.1° displaces crude at 41.8° API.

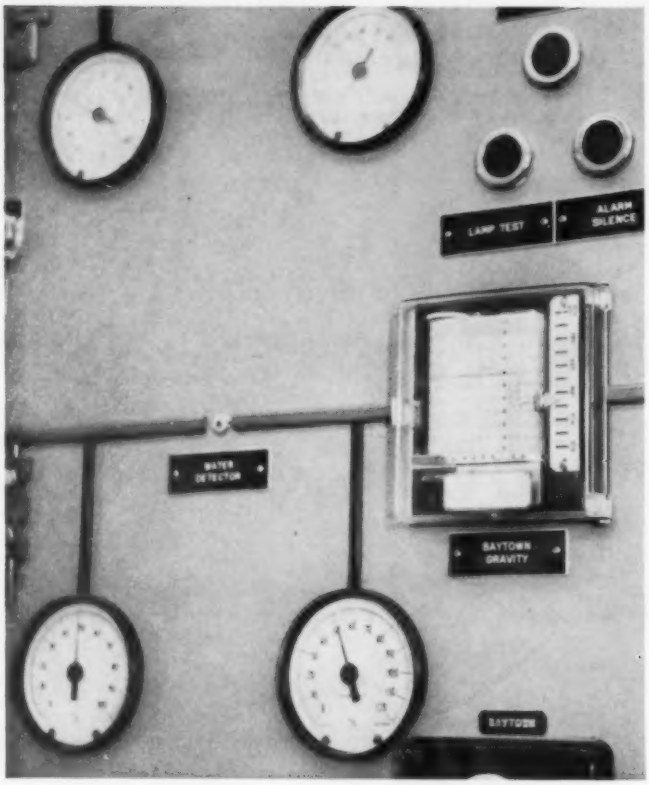


FIGURE 4—A readout of batch point detector on discharge line at the Satsuma station.

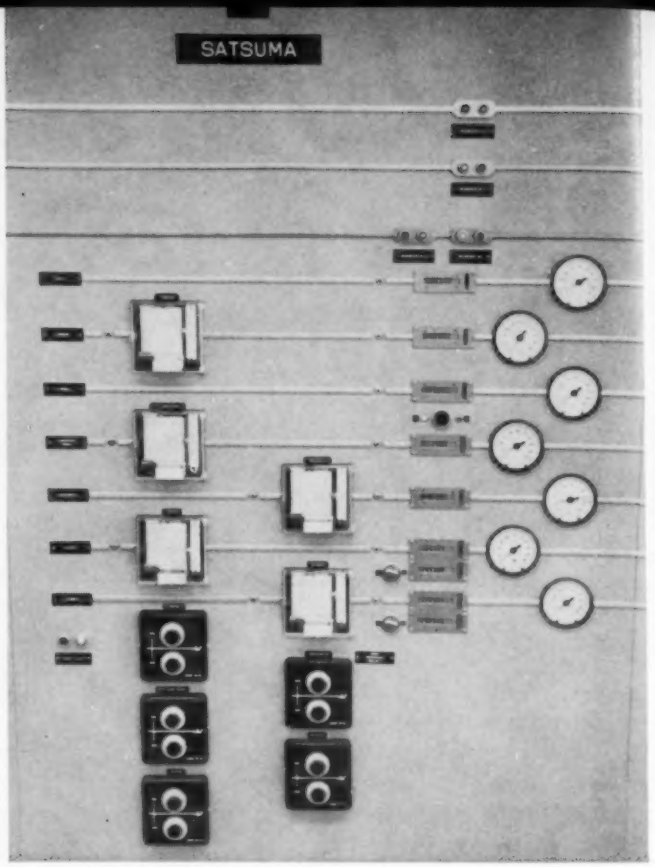


FIGURE 5—Batch point detector readout recorder on incoming crude lines at Satsuma.

pends on changes in specific gravity of the line fluids to alter the characteristics of an immersed vibrating paddle. Differences in mass affect the amplitude of vibrations of the paddle and its linkage; this, in turn, affects the amplitude of the signal it transmits to the pickup. This instrument was designed primarily as a liquid level detector. But because of its sensitivity to variations in specific gravities below its natural resonant density, the instrument should prove to be a valuable addition to crude and products pipelining.

The tuning fork detector was recently made available—so far as is known, the only instrument manufactured to date is on test on a products line near Dallas.

Variable Density Tuning Fork Detector. This instrument is a highly refined and precision-built gravity detecting and recording device. As an instrument, however, it goes beyond the role of mere detection—it is an excellent and accurate gravitometer, easily adaptable to clean liquids and products.

The range of the instrument varies from 25 to 75° API. It reads correct to the nearest ½° API and the full range corresponds to a frequency change from 278 to 293 cycles per second in the tuning fork.

Two tuning fork standards in the instrument provide a means of calibrating the instrument every hour. The calibrating forks are 556 cps and 586 cps, which are exactly double the frequency range of the density sensing fork.

The hourly calibration compares the 556 cps signal with the 25° API chart position and the 586 cps signal with the 75° API chart position. This is done automatically by the instrument every hour, and any required adjustments are made automatically—although they can be made manually from the front of the receiver panel if desired.

Another valuable feature of the instrument is its ability to correct (on demand) any gravity it detects to 60° F.

Experience at Humble's Irving Products Terminal has been favorable insofar as the instrument's ability to determine gravity of a flowing stream is concerned.

Despite its excellent qualifications, this type detector is probably limited to use on clean liquids which will not deposit solids within the tuning forks —at least so far as the original instrument is concerned.

The Vibrating Paddle Type Detector. This batch point detector has proved highly successful in detecting cut points in crude streams. The first installation on a products line was only recently made, and the results of the instrument in this service have not yet been ascertained. Laboratory tests, however, indicate that the instrument can detect a change in specific gravity as little as 0.3° API within certain ranges.

How the instrument works. The vibrating paddle is driven at 120 cycles per second by the driving coil of the unit. Amplitude of vibration of the paddle varies with the density of the surrounding fluid because of its resonant characteristics. A change in amplitude of the paddle changes the emf produced in the pickup coil.

Changes in size, weight and length of the paddle alter the resonant density and consequent output of the coil. Also, the response can be varied by changing the driving frequency and voltage.

A typical output curve of the instrument used in batch point detection of crude is shown in Figure 1.

This particular model becomes resonant in a fluid with a specific gravity slightly greater than water. Slope of the curve is greatest in the

specific gravity range corresponding to 10° to 60° API and thus sensitivity is greatest in the most useful range.

The instrument is installed in the pipe line through a 1½-inch collar saddled into the wall of the pipe. It is connected to the control circuit and recorder by a two-pair conductor (one pair shielded). Chart recorder and control bridge circuit may be in the station control room. They are connected to a 110-volt, 60 cycle power outlet.

Laboratory and field tests have shown that this instrument is sensitive to viscosity and stream velocity. Viscosity sensitivity aids in batch point detection—although it does limit the use of the instrument as a gravity change indicating device. Generally, the instruments designed for batch point detection have maximum sensitivity to gravity and minimum sensitivity to viscosity.

The vibrating paddle and its linkage must be shielded from stream velocity when it is inserted directly into the line. When one of the instruments was mounted in a 10-inch line which had a flow of 1,200 to 1,600 barrels per hour, the turbulence caused interference with the paddle and at times blocked the output signal. But this trouble cleared up when the instrument was inserted in a piece of one-inch pipe—open at one end and drilled to insure circulation.

Two of the instruments are in lines through which scrapers are run from time to time. To prevent damage to the paddle and its linkage, the unit was installed in a two-inch stub welded on the line at a 45 degree angle with the open end looking downstream. The length of the stub is such that there is clearance between the end of the paddle and the inside pipe wall.

One of the installations produced excellent results. It operated continuously for six months with no maintenance. Sensitivity at this location was set at 15° API full scale deflection.

Chart records from actual batch changes are shown in Figures 2 and 3. Figure 2 shows displacement of crude at 41.0° API followed by a crude at 36.0° API. Figure 3 shows the high sensitivity of the instrument in a crude at 42.1° API displacing a crude at 41.8° API.

FIGURE 6—A straight mounted detector sensing instrument is placed in crude line where scrapers are not run.

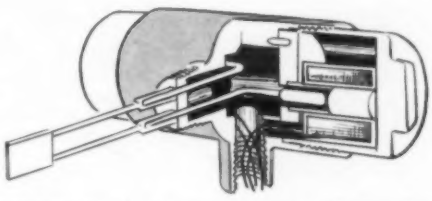


FIGURE 7—Cut-a-way view of the detector sensing instrument which detects changes in specific gravity of fluid.

About the Author

Ray Pfrehm, supervising engineer in charge of research and development of Humble Pipe Line Company, has served the company in various positions since 1947. Pfrehm received a B.S. degree in electrical engineering and communications from Southern Methodist University in 1947. He is a registered professional engineer in Texas and is the author of several papers on pipe line topics.

The response of the unit mounted directly in the pipe line is virtually instantaneous. This contrasts with other type instruments which require side stream sampling.

The vibrating paddle type instrument can be used successfully in a two-point system with one instrument located in the line at a remote point and the second instrument near the point of switching. With this system a warning is received of the approaching interface and of its size. The output of the two instruments are balanced against each other in a bridge circuit so that all upsets occurring to the instruments because of variations in supply voltage and frequency and outside interference are cancelled out, and only the variation in signal should be that occasioned by a change in density of the line liquid. Because of the low noise level in the two-point system, much greater sensitivity can be realized.

A two-point batch detection system was installed at Humble's Kemper station about 10 months ago. Both instruments are driven by the same regulated power supply, and their outputs are "nulled" in a bridge circuit. Thus, when both instruments are in the same density fluid the output is zero. As soon as the gravity starts changing at the upstream point, the two outputs become unbalanced, and it remains unbalanced so long at the interface is between the two instruments. But after the interface passes the downstream instrument, the combined output again becomes zero.

The combined outputs of the two instruments are recorded on a millivoltmeter. When the outputs are nulled, the recorder traces a straight line. When an interface appears, the deflection on the chart is proportional to the change in gravity. It goes back to zero, after the interface passes the second station.

Both of these instruments—the vibrating tuning fork and the vibrating paddle—are sensitive to changes in densities of line fluids, and both of them use the effects of these changes to dampen or enhance the transmission of vibrations to recording instruments. There is every indication that the two instruments will become worthwhile additions to the pipe line industry's kit of measurement devices.

—The End

A SPECIAL REPORT — AUTOMATIC CONTROL AND COMMUNICATIONS

Computers Move into Compressor Station Automation Picture

COMPETITION IN THE FUELS MARKET is back of gas pipe line companies' sudden high interest in automation. Coal and fuel oils are moving in on certain market areas and threatening to move in on others. As a result, natural gas pipe line companies are being forced to hold the line at the sales meter stations despite the rising costs of labor, materials and borrowed money.

In the past, the interest on the borrowed money ran higher than the cost of labor, and many companies took no more than a cursory glance at pioneer automatic compressor stations. But as competition at the market place increased, pipeliners started taking a hard look at anything which might save money.

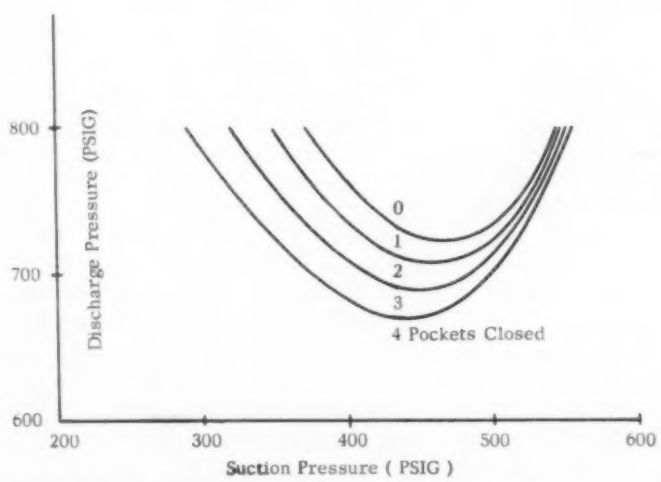
As a result, automatic compressor stations have captured widespread interest throughout the industry. They offer a reduction in labor and an increase in operating efficiency. The latter has a two-fold advantage: it cuts down on the use of fuel gas which has come to represent a sizeable operating cost, and it can effect a sizeable reduction in labor requirements.

Today, most of the major pipe line companies have experimental automatic compressor stations under construction or on the drafting boards. At the same time, the interest in existing automatic stations has sharpened.

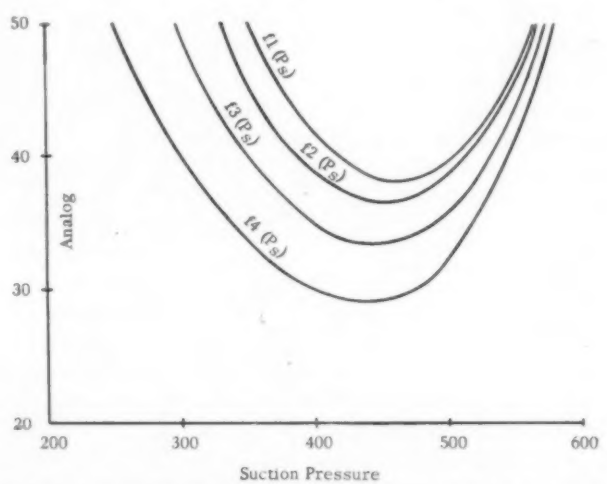
Columbia Gulf Transmission Company (as Gulf Interstate Gas Co.) was the first gas company to take advantage of the possibilities of automation. Today, the company has 10 stations spaced along its 840-mile main line which will be remotely controlled from a dispatcher's office in Nashville, Tenn., at this year's end.

HOW TRANSWESTERN USES COMPUTERS

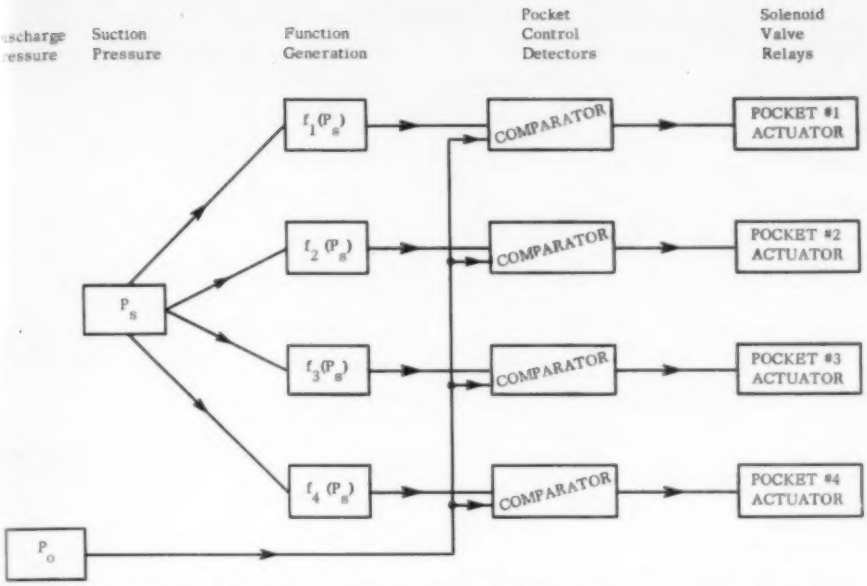
Transwestern Pipe Line Company's four main-line compressor stations on its Texas-California system are remotely controlled by a dispatcher in



OPERATING CURVES. Each curve shows suction and discharge pressures for equal horsepower. As the compression ratio increases (left) the volume throughput diminishes. As *r* decreases (right) the effect of opening and closing pockets is small.



FUNCTION CURVES. These curves are built into analog generator in computer. They duplicate the operating curves within about one percent. These curves are compared with discharge pressure analogs to determine the desirable pocket setting. (See text under Computer Control Clearance Pockets).



SYSTEM BLOCK DIAGRAM. The comparators balance electrical signal from analog computer to determine whether or not pockets should be opened or closed.

Roswell, N. M. One of the innovations of this system which went into operation last year, is the special computer analyzer in the Roswell dispatching center.

The purpose of this machine is to solve the complicated equations which govern the behavior of the centrifugal compressors at the stations. By setting into the machine known external conditions, the dispatcher can immediately calculate the operating conditions of each compressor.

The known information, suction and discharge pressure, flow, specific gravity and flowing temperature is dialed into the machine. The dispatcher can then select the number of units operating, the unit to be investigated and the type of problem to be solved.

The computer has four basic problems that can be automatically solved, given the required information. These are:

1. *Problem No 1. Solve for equal HP*

Given:
- A. Station Suction Pressure
- B. Station Discharge Pressure
- C. Gas Flow Rate
- D. Suction Temperature

Solve:
- A. HP
- B. RPM
- C. BMEP
- D. Compressor Efficiency.

2. *Problem No. 2. Solve for Equal RPM*

Given:
- A. Station Suction Pressure
- B. Station Discharge Pressure
- C. Gas Flow Rate
- D. Suction Temperature

Solve:
- A. RPM
- B. BMEP
- C. HP
- D. Compressor Efficiency

3. *Problem No. 3. Solve for equal BMEP.*

Given:
- A. Station Suction Pressure
- B. Station Discharge Pressure
- C. Gas Flow Rate
- D. Suction Temperature

Solve:
- A. BMEP
- B. HP
- C. RPM
- D. Compressor Efficiency

4. *Problem No. 4. Solve for Actual Operating Conditions.*

Given:
- A. Station Suction Pressure
- B. Station Discharge Pressure
- C. Gas Flow Rate
- D. Suction Temperature
- E. Engine Governor Setting

Solve:
- A. HP
- B. RPM
- C. BMEP
- D. Compressor Efficiency.

In addition, other problems of interest can be solved by having the machine in one of the problem positions and varying an input value until a desired computed valve is indicated. The computed values of BHP, BMEP, RPM, discharge pressure and compressor efficiency are read from dial ammeters.

Magnetic amplifiers and silicon diodes constitute a majority of the components; no vacuum tubes are used. Thus, the unit is virtually maintenance-free and has a comparatively low power consumption. The computer can operate with broad fluctuations in voltage and still maintain its design accuracy.

With this equipment, Transwestern has achieved the advantages of computer operation and retained the advantages a human dispatcher. Because the compressors are centrifugal, the sequencing of start ups, the control of the number of engines on the line and the set discharge pressure is sufficient to insure an efficient operation. However, if the units were reciprocating, the problem of achieving efficiency with clearance pockets would require additional controls—

COMPUTERS CONTROL CLEARANCE POCKETS

Pocket Controls. The biggest innovation in the field of automatic compressor stations is computers operation. Several suppliers of electronic equipment have devised means of opening and closing clearance pockets at remotely controlled stations to obtain the maximum efficiency out of the engine and to prevent overloading which could actually damage engines. (See curves and block diagram).

There are three companies which

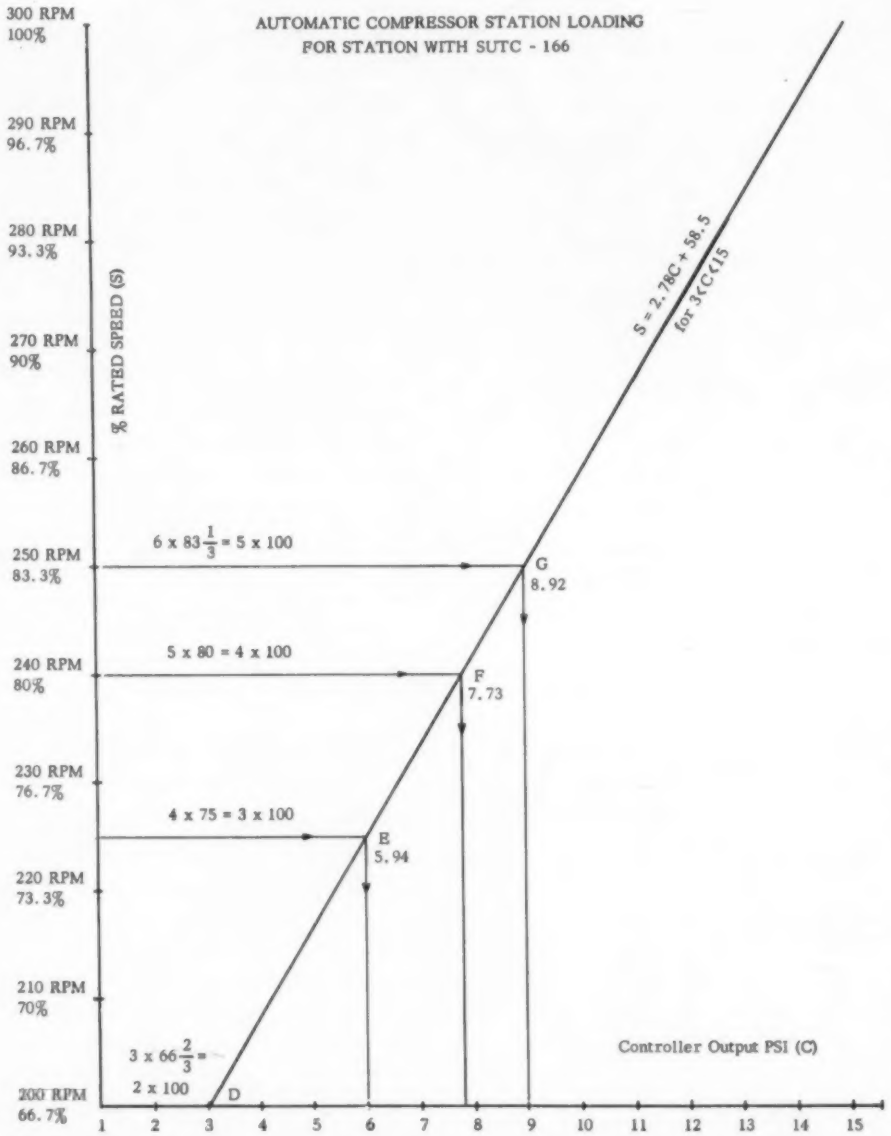
have designed computers for this purpose, and each of them uses different methods in achieving this control.

Before we go into the details of the operation, let's take a look at just what the design engineer is trying to achieve in automation.

Obviously, if any station is to be remotely controlled, it must have local automatic features. There must be shutdown controls to take care of damaging or dangerous operating conditions; there must be alarms to transmit knowledge of such conditions to the central supervisory center. In addition, there must be a sequencing of starting and stopping which will safely start an engine, warm it up and load it without depending on a multiplicity of signals from the dispatching center. The same goes for shutdowns.

For the most part, the various systems of achieving such control functions are quite similar. The variation between systems comes primarily from slightly different selections of hardware and from the increasing sophistication of the electronic components becoming available as our research programs continue in high gear.

For remote operations, engine-driven reciprocating compressors present a difficult problem. The clearance pockets—which vary in number from 4 to 10 as a rule—can affect the engine loading and efficiency. Under certain circumstances, when too many are closed, the engine will be over-torqued. At other times, perhaps three engines will be operating inefficiently, doing work which could better be accomplished by two engines.



Graph relating engine speed to governor control air is a straight line, having the equation, S = 2.78 C + 58.5 where S = speed in percent of rated speed (300 rpm) and C = controller output psi.

Engine operating curves. As shown in the accompanying drawing, the lines of equal horsepower for any one clearance pocket setting have great variance. The explanation is that if the horsepower developed by a particular engine remains the same, the volume of gas handled by different compression ratios will have to vary greatly. In other words, high compression ratio, low volume; low compression ratio, high volume.

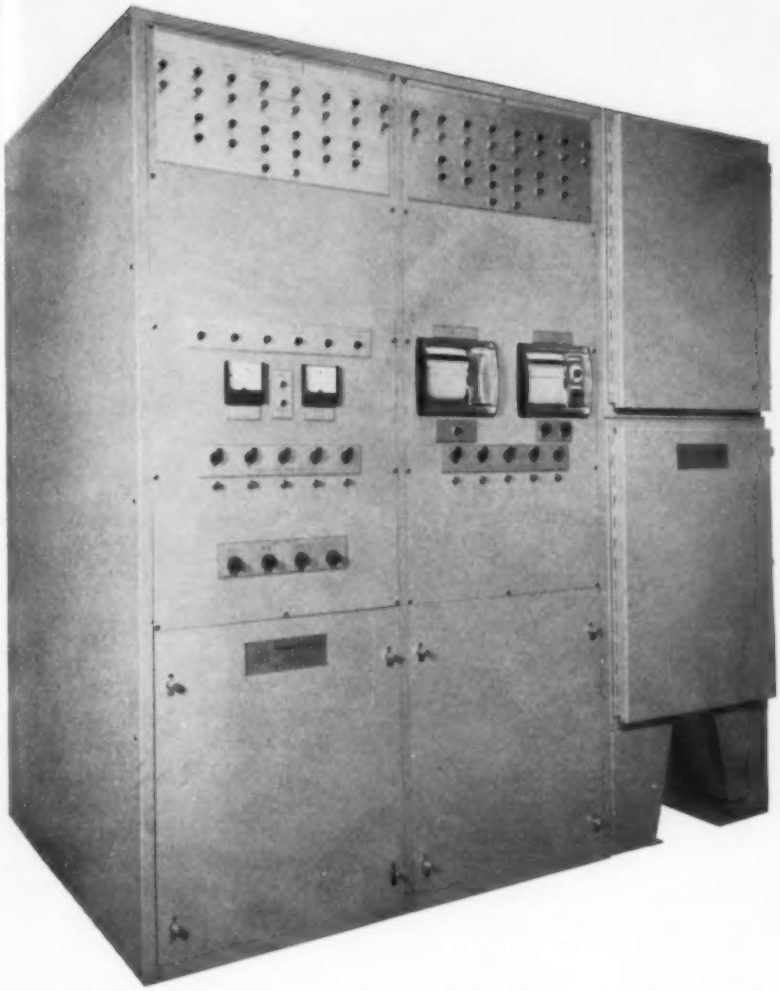
It goes almost without saying, that if each engine can operate as near to maximum efficiency as possible, the various engines at a station will log fewer hours over a period of time, and this in turn, can affect fuel and maintenance costs for the station.

One method of controlling clearance pockets of a reciprocating compressor incorporates these operating curves in an analog curve generator in a computer. These function curves can be generated by using multi-tapped precision potentiometers with intertap loading. The analog functions can duplicate within plus or minus 0.5 percent, of the engine curves. This is within safe limits, because the curves themselves have been smoothed and may have a plus or minus variation of three percent.

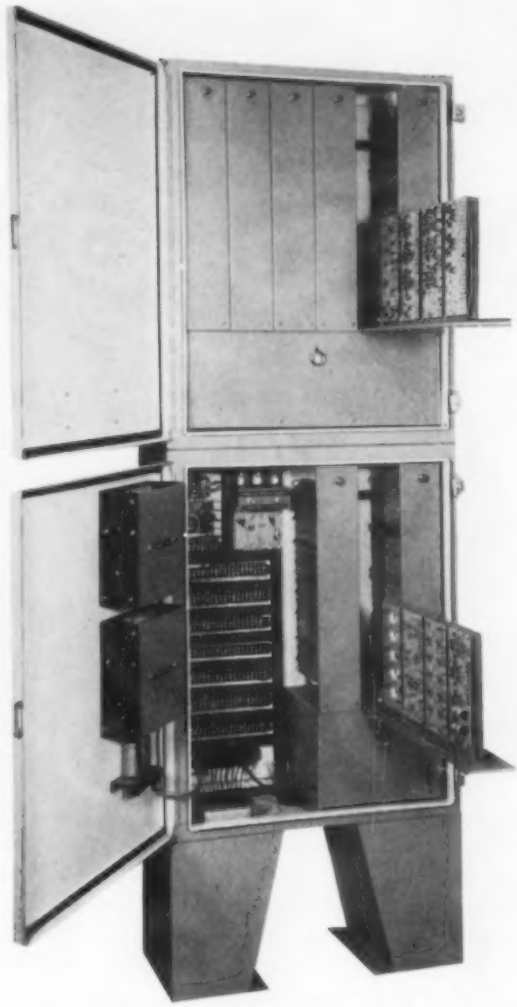
The analog of each function curve is fed into a comparator for comparison with an analog of the discharge pressure. The accompanying block diagram shows how this works. If the analog of discharge pressure is less than the analog of an operating curve, the corresponding pocket actuator relay is picked up, energizing the clearance pocket solenoid valve which then closes the pocket pneumatically.

This pocket actuation is cumulative, if Pocket No. 2 closes, it also closes No. 1; if Pocket No. 3 closes, it also closes Pockets No. 1 and 2. As the analog of the discharge pressure becomes greater than the analog of each operating curve, the proper clearance pockets open sequentially.

Compressor Station Load Control. This computer system, described in a paper by William F. Haley, of Union



Computer and control equipment for local compressor. Cabinet contains sequencing equipment and analog computer which derives torque from suction and discharge pressures and compares it with rated torque; then opens or closes pockets. (See text, Page 65)

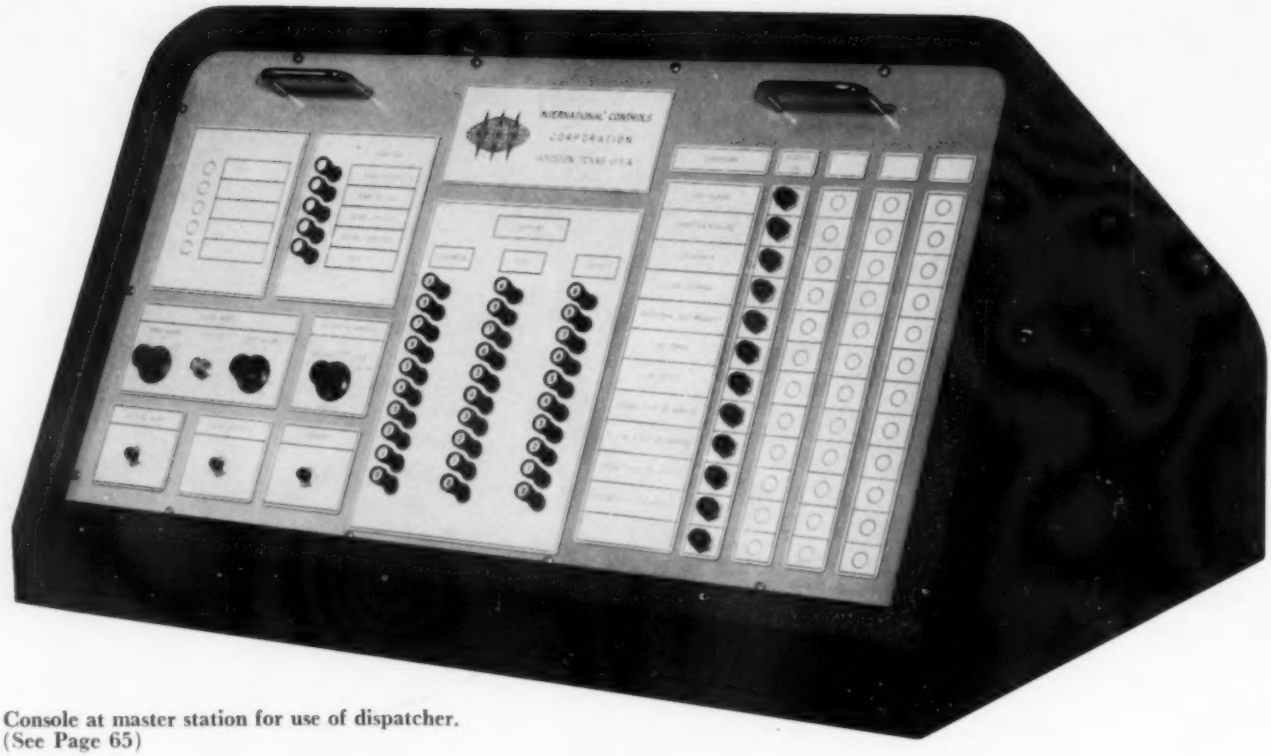


Master station equipment primarily consists of telemetering equipment which provides a means for dispatcher to exercise supervisory control. (See Page 65)

Switch and Signal, is based on maintaining a fixed discharge pressure determined by the actual throughput desired. Where there is more than one engine at a station, the function of the discharge pressure controller is to supply an output signal to all engine governors in multiple which will regulate the speed of all engines to maintain the set point pressure. Because most engine units on modern-day pipe lines are two-cycle with a relatively narrow range of high efficiency, the control is set to vary the speed within the range of 65 to 100 percent.

The changing of the number of units operating can be effected manually or automatically. Here is the way this is done. The pneumatic discharge pressure controller has an output signal of 3 to 15 psi to the engine governors connected in multiple to provide a speed variation of all units from 66⅔ to 100 percent of rated speed. This controller takes the discharge pressure set point and varies the pneumatic output signal to cause the engines to run at such a speed as to bring the system to operate at the called for discharge pressure. It does this by setting the engine governors of all engines to a fixed operating speed. It is then the function of the individual engine governors to maintain that called for speed, regardless of load, by sensing the operating speed of the engine—usually through a mechanical flyball-hydraulic amplifier linkage system—to vary the fuel supply to the engine to provide the proper amount of fuel to run the engine at a fixed speed regardless of load. The engine governors may be adjusted so they will not operate below minimum speed even though the input signal to them is less than 3 psi; nor will they operate above maximum rated speed if the input pneumatic signal is greater than 15 psi.

Basically, then, the output signal from the discharge pressure controller (3 to 15 psi) is an indication that proper range of power is available to provide the called for discharge pressure. If the power required is less than that necessary for the number of engines running at minimum speed (in other words, less than 3 psi) then the number of engines running must be too great and should be reduced by one. Likewise, if the power required for the necessary discharge pressure is greater than that provided by the engines running at maximum speed (greater than 15 psi) there must be an insufficient number of units running and one should be added. The limits of the pneumatic pressure signal thus provide a step function means of determining when additional engines should be shut down or added



Console at master station for use of dispatcher.
(See Page 65)

as the load varies over the operating speed range of the engine. Such a system might be operated with two pressure switches—for example, one set at 2.8 psi and the other set at 16 psi—so that if the speed signal falls below 2.8 an additional unit would be shutdown and if the discharge pressure governor signal rises to 16 psi, one unit should be added.

But such a system would not be economical because internal combustion engines operate most efficiently at near rated speed. It is evident that with a considerable number of engines available there would be overlap such that the same load conditions could be satisfied with one less engine running at a greater speed over one additional engine running at lower speed. The desirable thing of course would be to run the fewer number of engines at a greater speed, both from an economic standpoint of the fuel consumption and maintenance costs.

Thus it appears that the addition of an additional engine should always occur after the speed control signal has reached 16 psi since this indicates that all units running are running up to maximum speed. This would generally be true except when special operating conditions might dictate otherwise.

The reverse, however, is not true with regard to shutting down engines. Since the load is directly proportional to speed (assuming the torque is the same) it is evident that the shut down pressure signal varies with the number of engines running. The graph relating engine speed to governor control air signal is a straight line having the equation $S = 2.78C + 58.5$ where S = speed in percent of rated speed (300 rpm) and C = controller output psi. 15 psi corresponds to 100 percent speed and 3 psi corresponds to 66 2/3 percent speed.

For example, with a 3 to 15 psi signal for a speed control of 66 2/3 to 100 percent with six engines running at 83 percent speed (5/6). This is equal in power to five engines running at 100 percent speed. This speed point occurs at 8.92 psi governor air signal. If five engines are running, when the speed reduces to 80 percent this is equal to four engines running at 100 percent speed, corresponding to a speed signal of 7.73 psi. If four engines are running and the speed requirement reduces to 75 percent this is equal to three engines running at 100 percent speed, corresponding to a speed signal of 5.94 psi. It is therefore evident that, as far as shutdown is concerned, a separate pressure switch and engines running counting circuit is necessary in order to determine when an engine can most economically be shut down. The setting of the shutdown pressure switches should be made at a slightly lower pressure than that calculated (perhaps 5 percent) in order to provide some overlap. This will insure that, if the load should increase just when the engine is shut down, the pneumatic control signal does not go to over 16 psi and call for the engine to start back up again.

It should be noted that with one to two engines running there may be a load range which is difficult to match. This could be caused by two engines at minimum speed providing more power than needed and one engine, at maximum speed providing insufficient power. Under this condition, a cycling from one to two engines back to one engine will occur. This will provide a duty cycle with the desired average value of power. The cycling time is regulated by the 15-minute line stabilizing timer.

To provide station shut-down, the discharge pressure set point can be adjusted to a value less than line pressure with no units pumping. This will result in the last engine running being shutdown since the governor air signal will be less than 2.0 psi.

The load control system has the following time delays: After the change occurs in any of the pressure switches, the change must be maintained for one minute. This will in-

Continued on Page 65

A SPECIAL REPORT — AUTOMATIC CONTROL AND COMMUNICATIONS

What Crude Lines Need Most In the Field of Automation

By Allen R. Heidebrecht, Manager of Operations and Engineering
Platte Pipe Line Co., Kansas City, Mo.

THE TECHNOLOGY of automation has advanced by leaps and bounds. Now it's time to pause and establish standards. This is the biggest need in this phase of the industry today.

Our advances during the past 10 years have been amazing. Push-button controls for remote installations are commonplace—as are fabulous multi-channel communications systems. So rapid has been the pace, that most industry organizations (and individuals as well) have been too engrossed in the technology and construction work involved in this field to take the time to look back and study their progress. But now we must take the time for this backward look so we can intelligently chart our future course.

Standardization is Lacking. Somewhere along the line, the value of simplicity was overlooked—especially as related to instruction manuals and wiring diagrams which are used to explain instruments to the men who must maintain them. No attempt has been made to standardize these all-important aids to instrument maintenance. As a result we not only have *exotic* instruments which are often hard to comprehend —we also have *exotic* instruction manuals and wiring diagrams which sometimes are almost unfathomable.

Standardization of product—whether in the field of consumer goods, or in pipe line instruments has definite advantages to the user. And it is high time we took steps to gain these advantages in this particular field.

Why shouldn't we have standardized "off-the-shelf" components which are interchangeable? Operating techniques in certain phases of pipe line automation have been standardized to the point where such components could be made available by manufacturers. A case in point is the starting and stopping sequencing equipment used with centrifugal pump motors.

Also, there are many advantages that would result if spare groups of standardized instrument components could be pre-set, pre-tested, calibrated and swapped out with instruments in the field from time to time. This would permit centralized shop repairs and calibrations which would be superior and less expensive than similar work carried out in the field. A move in this direction would be greatly aided if instrument manufacturers produced interchangeable parts.

Progress in standardization has lagged behind progress in automation in general. Several organizations, including the Instrument Society of America, the AIEE and the API, have published bulletins and reports covering certain specific areas of interest in automation. Recently, the Petroleum Industry Electrical Association announced plans to devote more attention in the future to automation within the petroleum industry. This is good news. The PIEA has an outstanding 33-year record of significant contributions to the technology involved in Wire and Radio Communications, Electrification & Corrosion Control, and now that the PIEA has announced its intention to delve deeper into automation, the petroleum industry is certain to benefit tremendously from the technological standpoint.

But the task of over-all standardization and uniformity of specification has only just begun.

The API Central Committee on Communications Facilities, re-orzanized last year, now has a standing group committee dedicated to the coordination and development of communications circuits and techniques for automation and data transmission. The committee is designated as Group 7C4 "Automation and Data Transmission" of Section C (Technical). Communications circuits for automation and data transmission are, and certainly will be, more important as the industry progresses further into automation. It is certainly most gratifying to know that such a group is formed and working on current and future problems.

Early last fall, the American Standards Association invited 35 trade associations and technical societies to participate in an exploratory conference on Automation Standardization. Group 5A8 "Automation and Instrumentation" of Section A "Engineering & Technical," Division of Transportation, was designated as representative from the American Petroleum Institute. Briefly, the group agreed that a need existed for coordination of standardization efforts of the individual organizations involved in the formation of standards. It was also agreed that even if ultimate coordination could not be accomplished, any results obtained to agree on automation terminology, definitions and symbols would be worthwhile.

During the conference, the representatives of the various associations and societies unanimously approved a motion authorizing the ASA Standards Council to set up the structure of a new committee to consider the points of view expressed at the conference and to develop a recommendation under which standardization efforts could be coordinated. This committee is now being formed and although no progress can be reported

About the Author

Allen R. Heidebrecht joined Platte Pipe Line Co. in 1950, became chief engineer in January 1953, and moved up to his present position of manager of operations and engineering in 1957. He was graduated from Kansas State College in 1934 with a B.S. degree in electrical engineering and started work immediately for Kansas Gas and Electric Co. where he remained until joining Platte. Heidebrecht is group leader of the API Automation and Instrumentation Group 5A8 and a member of the Petroleum Industry Committee in the AIEE.

at this time, it is encouraging to realize that all technical societies are thinking along similar lines. The API will be represented on this committee by the Chairman of Group 5A8.

It appears that the petroleum industry is in a relatively good position now to close ranks and proceed through its various specialized organizations to assault the task at hand. It will probably be quite a while before one manufacturer's instruments will slide into and work in another's case or before all control panels have standard symbol and light patterns, or before all sequencing panels look alike, but with that as a goal, standardization will surely cause component and performance specifications to acquire a similarity and this will lead to the development of better, more reliable, more serviceable equipment.

It will be most interesting to follow the progress in standardization of equipments used for automation. We will, no doubt, read announcements and advertisements for new families of instruments and all kinds of devices proclaiming standard outputs, mounting dimensions, control characteristics and various other features, all a result of standardization and uniformity of specification. Now is the time for everyone in the industry to act in the support of the various industry committees by extending to them their substantive suggestions or constructive criticism.

—The End

A SPECIAL REPORT — AUTOMATIC CONTROL AND COMMUNICATIONS

Object for Engineers: Systems Optimization

We need mathematical pilot plants for gas pipe line design problems

By Carlton C. Homan, Chief Engineer
El Paso Natural Gas Co.

SYSTEMS OPTIMIZATION can provide the solution to most of the problems besetting the natural gas industry today, and the most logical way to achieve it is through computer handling of design problems and through use of automatic control equipment in the field.

Just what do we mean by the term, *systems optimization,* as related to the natural gas industry? One definition is that an optimized system is one that is designed to deliver natural gas to the consumer in the most efficient and economical manner possible—and in the best interest of the public.

While this concept is by no means new or original, it is highly germane to the problems facing our industry, and it is time we give serious thought to optimization and how it can be achieved.

We all know that compressor stations can be remotely controlled today. Many are, and they achieve a better utilization of manpower. But this is only a partial solution to our problems. Let's go back a step and take a look at our basic problems.

How Our Systems Have Grown. We have repeatedly expanded our systems to meet customers' needs in what is presumed to be the most economical manner. But have we actually done this? In most cases our systems are so complex that time does not permit us to study all of the problems involved and therefore we likely did not achieve the "optimum." When you consider all factors that need to be considered, such as weather, overall system capacity, gas supply, storage, existing gas sales contracts, curtailments, peak handling capacity, diversity factors and reliability of equipment, the problem becomes tremendous.

In other words, we should know what our system's *transient* behavior is before we add to it. If we know what its capabilities were at all times, all hours and days throughout the year for varying demands, we could determine whether or not we have to add to its capacity for a new demand and time. This could, in effect, be called "capital investment optimization."

One solution would be to provide a reservoir of sufficient size to enable us to pump into it at a constant rate while we are withdrawing at a variable rate. Such a reservoir is not available today and hence we have to look for another solution.

Automatic Control. In order to reduce costs, we have done a considera-

ble amount of automation. We have automatic start-stop control for compressor equipment. We have automatic pressure, flow and temperature control equipment etc. We have added these devices to improve operation and reduce costs.

Now we need to optimize the operation of these devices. This would mean optimizing the loading of compressor stations, optimizing the division of loading between compressor stations, the division of flows between alternate routes and alternate gas supplies and achieving the optimum pressure on a transmission system for varying conditions and time.

Capital Investment. We should not forget the capital investment we have to make to increase our capacity to transport gas. Initial investment plays an important part in the "optimization" of our system. Today, the reciprocating engine is an efficient prime mover as far as fuel consumption is concerned, but its cost of installation and maintenance is high. The gas turbine is lower in efficiency, but its cost of maintenance is lower. The electric motor driven station could be the best because of its low installed cost and maintenance, but usually electric energy costs offset these advantages. (it certainly would be the easiest to automate.)

We also need to further reduce the installed cost of pipe lines. Perhaps the greatest improvement could be in the chemistry of the pipe metal itself, enabling us to increase our working pressure economically. In other words, we want to reduce our installed cost per horsepower and mile of pipe. These costs, or fixed charges, are a major part of our total costs. Other major operational costs are maintenance, labor and fuel. To optimize, we must keep these at a minimum.

Systems Optimization. The problems demonstrate the need for *"Systems Optimization."*

How do we achieve this? Several pipe line companies have made progress in this direction by remotely controlling a complete system from a central point, but we are still basically telling a device what to do from a remote point but not *"how and why."*

In some cases "slave" computers have been employed at compressor stations to determine how to operate

Close-up view of control console at Williams, Ariz., which remotely controls El Paso Natural Gas Company's Seligman, Ariz., compressor station. Unit is housed in pressurized control room.

the station with a partial answer as to why. "Why" being, in this case, to operate the station in a most economical manner for the job to be done. In addition, consideration is being given to the use of a master computer to control the slave computer. This is where the problem begins to get complex when considering the "how and why."

We recognize today that the tools and "hardware" are available to automate a system. We have the reliable communication systems, remote control equipment, data transmittal devices and we have reliable computers. The answer to our problem will be how and why to put these tools to use.

One approach to this problem is to attempt to first express mathematically the system with which we are concerned, keeping in mind that there is an optimum manner in which to produce and transport our product.

For one set of conditions and time we can easily express methematically our problem and solve it. This is basically what we do when we design our system and/or add to it physically. When we are faced with varying conditions and time the problem becomes complex. If sales and demands fluctuate hourly or daily, we must know at what time their fluctuations will influence the operation of each compressor station such that we may schedule their operation, thereby minimizing continually the cost of gas transportation. This also applies in the production field, and again we need to know how and at what time these fluctuations will influence the operation of the fields. Add to these varying conditions and time, the fact that we are working with a compressible fluid, then the problem becomes even more complex. If this mathematical expression can be written, it becomes a tool which we can use with a computer to find the answers to our optimization problem. If we properly construct this mathematical tool it becomes a **"mathematical pilot plant"** and will give us continuous answers to our questions of "how and why" and then we can effectively automate our pipe line system.

In summation, we should realize that the application and the utilization of automatic equipment and remote controlled equipment is not the final answer. We must provide ourselves with the tool that tells us how and why to utilize the automatic equipment and when to add to our system capacity. We must operate our systems at a minimum cost continuously with time and varying conditions. There is a minimum cost; we need to find it. We feel that the "mathematical pilot plant," properly used with a computer, is the answer.

About the Author

Carlton C. Homan, Jr., has been with El Paso Natural Gas Company since 1946. He was named chief engineer in 1957. Homan received a B.S. degree in electrical engineering from Texas A.&M. College in 1942. He is a registered professional engineer in Texas, New Mexico and Arizona. In 1958, he was awarded the "Outstanding Engineer of the Year" title by the El Paso Chapter of the Texas Society of Professional Engineers.

ACKNOWLEDGMENT

From a paper presented at the Winter Instrument Automation Conference of the Instrument Society of America, St. Louis, Mo. Jan. 17-19, 1961.

Integrally Reinforced Forgings for Branch Connections

Insert butt-welding nozzles with smooth tapered design minimize stress concentrations.

By William M. Jackson
Vice President, Bonney Forge and Tool Works, Allentown, Pa.

SOME SEVERE PROBLEMS involved in making branch connections have been solved by an integrally reinforced forging which has a tapered contour with no sharp change in direction or wall thickness. With this type design, stress intensification factors have ranged from 1.3 to 1.75 on stress analysis as compared with comparable size lap type reinforced nozzles with factors of 2.2 to 3.0. Stress analysis tests indicate that the efficiency of this branch connection is excellent.

How the Fitting Was Developed. Almost a decade ago, my company started a research and development program aimed at improving the design of critically stressed branch pipe connections. Any branch connection, because of its nature, has three strikes against it from the stress standpoint: First, any hole in a plate or pipe subject to any force, creates high stress concentrations at its edges; second, the abrupt change in direction provides a vulnerable "notch" for stresses to concentrate; third, the attachment weld at the point of intersection adds an additional notch effect. By themselves these factors are not difficult to deal with, but added together, they can, and do, cause failures in highly stressed piping systems.

In general, the piping industry has favored the theory of *area replacement* only for adequate and acceptable branch pipe reinforcement. Our research group questioned this premise, taking the position that various shapes affect the adequacy of reinforcement as much or more that the area replacement. This theorem has appeared in the company literature for years and was the subject of many discussions and debates with piping designers during the last two decades. In 1954, it was proposed that the piping code take a broader approach to branch reinforcement than just considering one aspect of reinforcement, *area replacement,* as a criterion of adequacy. (*Area Replacement* reinforcement involves replacing the cross sectional area of the hole in the pipe as the cross sectional area of extra reinforcing metal within a prescribed zone.) Although this recommendation was not made a part of the code at the time, because of anticipated administrative difficulties (nor has it changed as yet) the broad approach to branch reinforcement of *both* "shape" and "amount" is still fundamental, and it

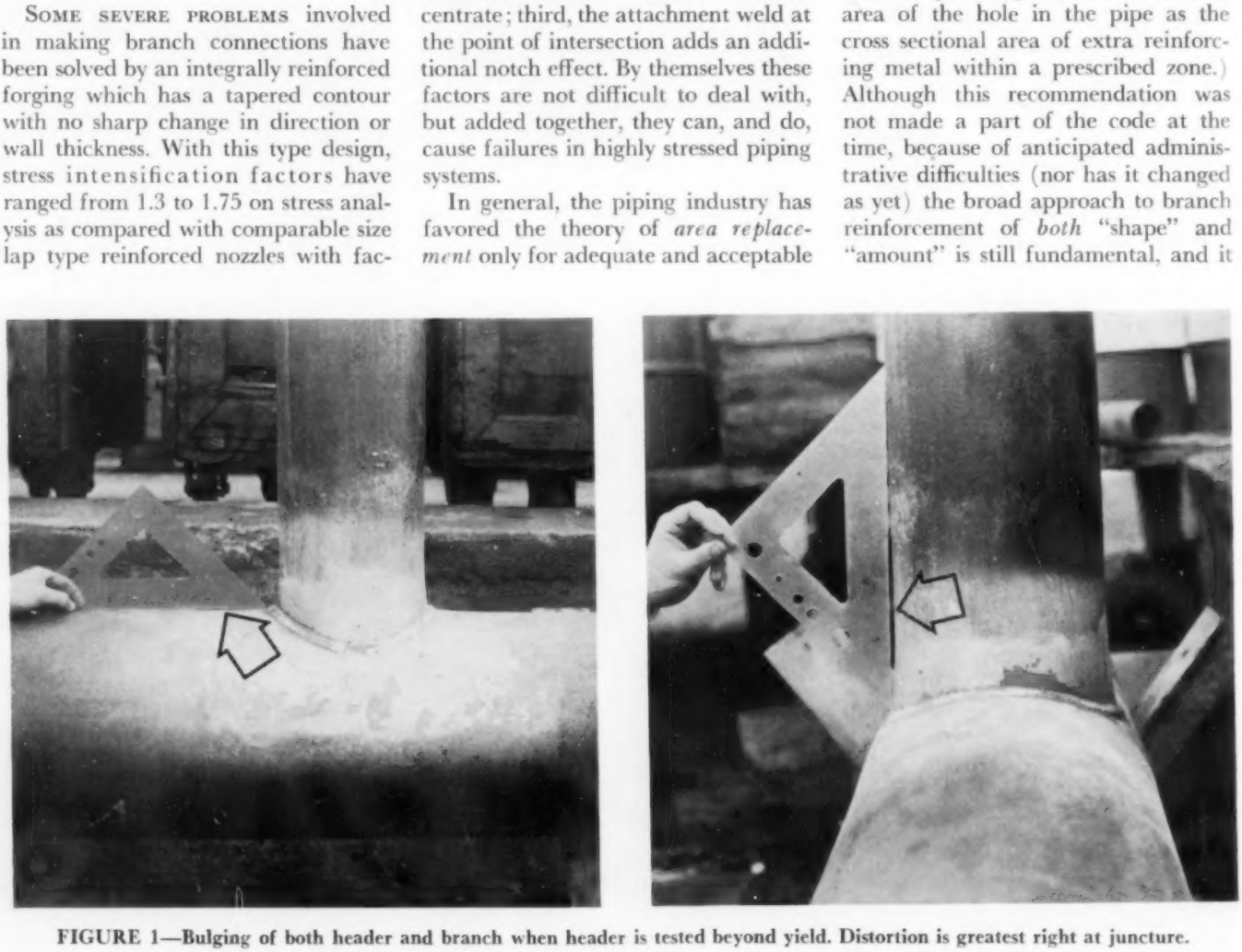


FIGURE 1—Bulging of both header and branch when header is tested beyond yield. Distortion is greatest right at juncture.

FIGURE 2—Fine lines in stress-coat show direction, amount of stress. Note heavy concentration at intersection of branch and header. Lines with numbers were drawn at different pressure increments to outline extent of stress line propagation.

was this approach that was followed in developing the design of the sweep outlet fitting.

To state this fundamental in another way, it is evident that if the code requires a certain *amount* of reinforcement, the branch joint will be stronger if the reinforcing material is placed efficiently than if it is not. Going a step further, the code does not designate more or less efficient ways of placing the reinforcement; therefore, reinforcement of somewhat less than the code required amount, if placed efficiently, would provide a stronger joint than the required amount placed in an inefficient manner. The question is—How much less?—and What is an efficient *manner* of placing reinforcement? What is the optimum shape and what is the proper amount?

Shape of the Fittings. First, let's take a look at shape. It is generally agreed that certain types of reinforcement are more desirable than others. For example, the "Unfired Pressure Vessel Code" Case No. 1234 requires among other things for nuclear vessel openings that "any compensation required shall be integral with the vessel wall, or the nozzle or some with each." Likewise in a paper entitled "Fabricated Pressure Piping as Related to Nuclear Applications," presented by Messrs. Murphy, Soderberg, Blumberg and Rossheim, various types of reinforcement were classified so the more desirable *shapes* would be used in the most severe services and the less desirable shapes were limited to less severe services.

Early in our testing program to investigate stresses around branch connections and the means by which they could best be compensated, a stress-coat analysis was conducted of an unreinforced nozzle connection. Several points were pertinent to subsequent reinforcement design. The branch tended to pull out of the header and a slight rise in the top surface of the header can be seen adjacent to the nozzle. This has also been reported in previous papers. Likewise the bottom portion of the nozzle where it joins the header as well as the header itself expands outward near the juncture (see Figures 1 and 2).

In addition to this distortion, it is important to note the stress concentration near the juncture (as shown in the photographs). As the distance from the juncture increases, the magnitude of the stresses decreases substantially. It is, therefore logical to assume that reinforcement is most efficiently placed close to the juncture and that the efficiency of reinforcing metal in both header and branch decreases as the distance away from the juncture increases. The premise of reinforcement by means of smooth tapered fittings is that the reinforcement should be *close to the juncture,* and the design of the sweep outlet fitting is a further refinement of this premise.

The next step in developing the sweep outlet shape was the stress analysis of welded construction branches. Over a dozen such headers were subjected to stress analysis and subsequent testing to destruction. Although in all cases, the sweep type fittings adequately reinforced the joint to full pipe strength and all fractures occurred well above the required bursting strength of the pipe, it was evident that the optimum design of a branch connection would be one that would adequately distribute stresses and prevent distortion of the joint without introducing any new points of stress concentration as a result of its own deformation, etc. These points had been determined to be due to geometrical discontinuities or, in short, "notches." The factors creating notches in branch connections are *abrupt changes in direction, abrupt changes in thickness* and *the welded joint* at or adjacent to the stressed area. When these factors all occur at the same location their detrimental effects are additive. The qualitative design of the sweep outlet was one not only to separate these factors from each other but to eliminate the abrupt changes in direction

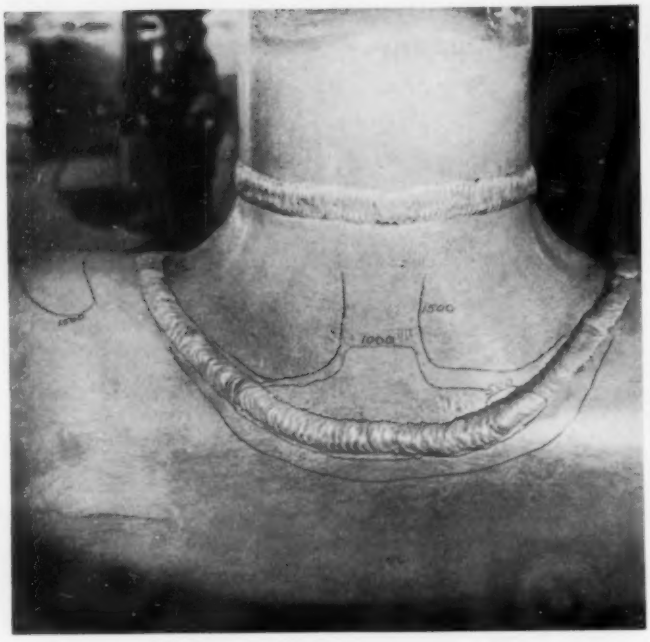


FIGURE 3—Well dispersed stress lines indicate high integrity design of sweep outlet fitting with low stress concentration.

FIGURE 4—Crayoned stress-coat lines show dispersion of stresses and approximate equality of stress at crotch and in skirt.

and thickness and to place the weld, well away from the otherwise critical areas. And so the sweep outlet shape evolved.

The Amount of Reinforcement. The above qualitative factors were developed quantitatively by experimental tests starting with sweep fittings which were purposely designed undersize. In this manner, it was possible to build up additional reinforcement in steps to provide full pipe strength without going to a reinforcement that was so heavy that the change in thickness from pipe wall to reinforcing section would in itself create an abrupt change in thickness or "notch." This also made it possible to maintain a relatively flexible connection which when subject to pulsating pressures or external forces would not have inherent notches where the stresses would concentrate.

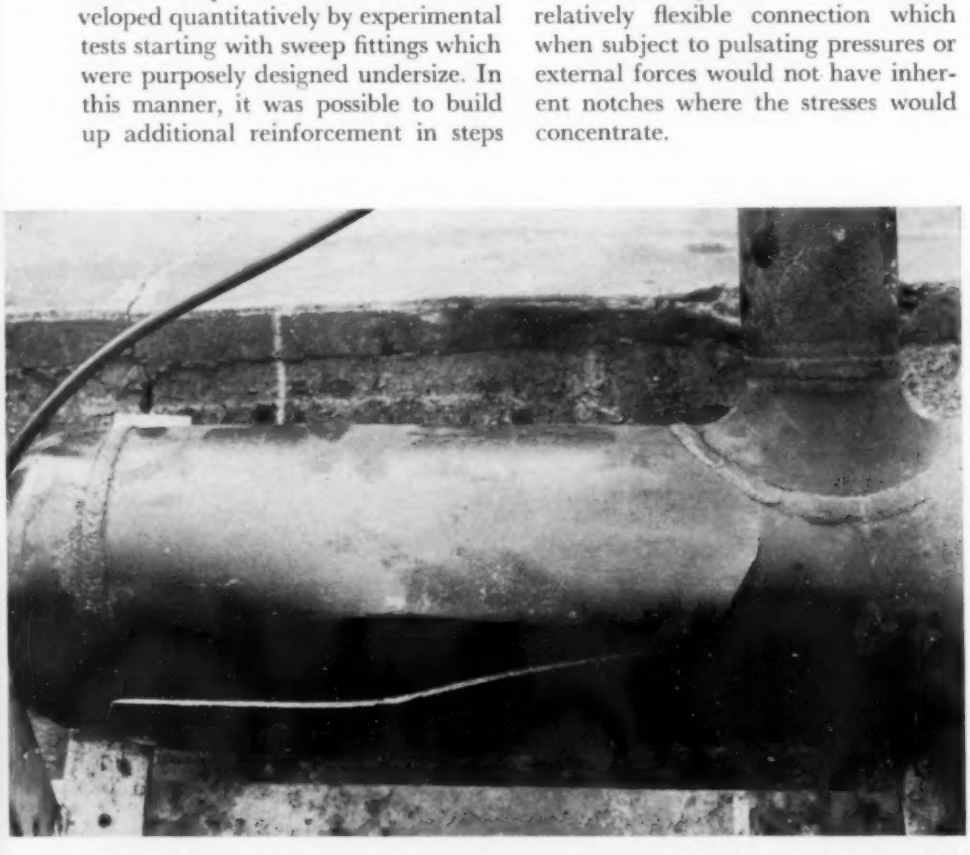


FIGURE 5—Bursting pressure tests resulted in wide dispersal of failure locations. This one is in the unaffected portion of the pipe between the sweep outlet fitting and the cap on the test assembly.

Efficiency of Fittings. It is interesting to compare the sweep outlet characteristics with the information developed by the Pressure Vessel Research Committee, even though the work is not yet complete. PVRC has determined that an efficiently reinforced branch (general sweep outlet shape) developes full strength at about 65 percent area replacement and further area replacement has virtually no value. Sweep outlets provide between 65 and 70 percent area replacement when interpreted under the most vigorous terms. With a reasonable engineering interpretation of the extremities of the reinforcing zone applied to the sweep outlet construction, however, the sweep outlet meets 100 percent area replacement requirements in accordance with ASA B31.1, an important point while that requirement is still with us.

Testing. The final designs of various size sweep outlets were tested for both the qualitative and quantitative basis for the design, the shape and the amount of material. In test assemblies the locations of the failures were scattered throughout the headers. Theoretically a perfect design would result in equal stresses at all points. Tests failures have been halfway between the sweep outlet and the end cap, on the bottom side of the header, on both sides of the insert weld approximately one-inch away but not associated with

FIGURE 6—Fabrication of one-inch thick compressor bottles with 10-inch and 12-inch sweep outlet fittings.

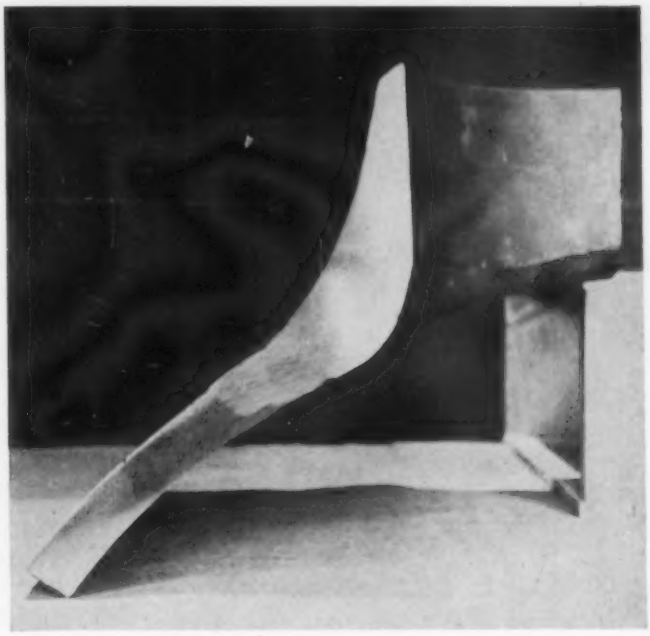


FIGURE 7—The cross section of the fitting and the adjoining section of run pipe.

the toe of the weld, and in the branch pipe proper, well away from the weld.

Pressure pulsation tests have been run on a 0.312 wall 30-inch diameter, 5LX42 header with 6, 8 and 12 inch sweep outlets respectively. Pressures between 50 and 90 percent of yield were used to produce failure. Failure occurred adjacent to the 8-inch sweep outlet after 93,000 cycles. The header was cut apart, re-welded and tested further. The next failures took place in the 12-inch fitting at 128,000 cycles. It is interesting to compare this with various sizes of saddle reinforced branch connections which have been tested in this manner. The pressure pulsation tests on saddle reinforced branches which are published by AGA[1] failed at the following number of cycles: 23,900; 22,200; 48,600; 31,-600; 78,600 and 7,000.

It is pertinent to observe that the pressure vessel industry has considered the integrally reinforced insert type nozzle as a highly desirable type of construction for a number of years. It has been used for pressure vessel openings where the services are extremely severe, but economics have prevented wide spread use of the insert nozzle as it has been available only as a custom-made product. The Pressure Vessel Industry, currently involved in research on the very problem of reinforcement of openings, has this interesting quote from the Welding Research Council's Annual Report, "an effort is being made to develop means for advancing practical methods of design by reducing or eliminating high stress concentrations by means of improving configurations . . . The purpose of the work is to determine the magnitude of the stress concentration near various sizes of reinforced openings, and to find an *optimum amount and shape* of reinforcing material."

Several more years of research are probably necessary before conclusions are definitely reached by PVRC on the method of branch construction for optimum stress distribution. In the meantime, this basic research has been conceived, carried out and made operational in the sweep outlet, giving the industry a unique head start on trying and testing this new design and fabrication. Several pipe line companies have installed sweep outlets throughout major construction programs and many have used them this past year for installation and operating tests. One outstanding factor is that the basic design theory is excellent. It remains only to work out the balance of service and economy to determine where the cost of sweep outlet construction is warranted by the stress problems. The present primary application of the sweep outlet design is in the gas and oil transmission pipe line industry where operating stress levels are high and optimum design is imperative. But, in due course, in anticipation of stress levels being increased in all phases of the piping industry, the sweep outlet construction will likely become one of the major methods of constructing branch pipe connections.

About the Author

William M. Jackson, vice president and division manager of Bonney Forge and Tool Works, Allentown, Pa., has been with his company since 1947 when he graduated from Princeton University with honors with a B.S. in mechanical engineering. Part of his undergraduate work was at M.I.T. Jackson has held positions in sales and development engineering prior to positions in general management. In the early 1950's he headed the research project leading to the development of the fittings described here. He has been awarded three patents on pipe fittings. For the past decade he has served on several American Standards committees, including the B31.1 for pressure piping, the B16.9 for butt welding fittings and the B16.11 for socket welding fittings.

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[1] Branch Connections Report II, American Gas Association.

Wives join group for briefing and discussion during final week of BCIU's Training Program for international business executives. Here, they informally cover important points. This "close-out" session helps crystallize key problem areas.

The 'Ugly American' Gets a Face Lifting

People in other nations have been seeing a distorted, one-sided and unlikable picture of foreign-based American businessmen. Now a new school is helping overseas personnel show the other side of the coin

By Kerryn King, Texaco Inc.

MANY PEOPLE overseas regard Americans with distrust. They are semi-villains—not particularly liked—frequently misunderstood—often unwanted.

Since the end of World War II, as our involvement and responsibilities in foreign areas have grown, some American business executives have found this so in their dealings with foreign nationals.

Formation of BCIU. Since the fall of 1959, American executives enrolled in an intensive four-week course conducted by the Business Council for International Understanding (BCIU), at The American University in Washington, D. C., have been working to improve the American image. The course is designed to do something about the need for better preparation of Americans involved in foreign business relations. The program acquaints businessmen with social, political, and other conditions in countries where they will work. It also tries to help them better interpret the U.S. and understand people in foreign countries—to see how their views differ or coincide with those of Americans, and why.

Representatives of both the State Department and the United States Information Agency often lead discussions during the run of the course. They make themselves available for consultation with businessmen who want more detailed information about their areas.

Views of a Statesman. One of the most well-informed BCIU speakers is Douglas Dillon, now Secretary of the Treasury. In an address delivered at Williams College, he said:

"Private American business and other groups are also recognizing the need to prepare their representatives for work abroad. Many of them run their own company or institutional programs. Others send their people to our universities. Recently, leading executives of U.S. companies doing business overseas established the Business Council for International Understanding . . . This program fills two closely related needs: First, to send overseas individuals who are better prepared to make a success of their assignment for their companies; and, second, to build goodwill for the United States . . . It . . . holds out great promise—for the private sector of our economy is the very antithesis of the state enterprise that is central to Communist doctrine. It is perforce the very best advertisement of freedom at work . . ."

Many more examples of freedom at work are needed to combat the organized Communist propaganda attacks that come from behind the Iron Curtain. Because of this threat, a key development in U.S. foreign policy in recent years has been the growing impact of free enterprise in international diplomacy. All over the free world—in underdeveloped areas and in countries with long-established industrial economies—public money and private money have been working together as never before.

The Postwar Boom. At the end of the war, the United States began assuming unaccustomed international responsibilities—both political and

economic. At the same time, American business began a new and rapid expansion overseas, in response to economic opportunity and necessity.

As America became more involved in the internal affairs of nations abroad, both government and industry were rudely awakened. They awoke to the complexity of their problems and relationships in some foreign areas. This, of course, was not true in every case. There are tens of thousands of American businessmen ably representing their companies in nearly every free-world country.

With few exceptions, these businessmen in foreign countries go about their day-to-day duties honestly, diligently, fairly, and with best intentions. It takes a lot of capital and courage to strike out into new areas far from the home office. Many of our large corporations which have the capital and courage have made important friendships overseas.

These friendships not only benefit the company, but reflect great credit on our country's way of life. They are the kind of achievements that a diplomat, no matter how capable, cannot hope to duplicate. They are also the kind of achievements that go unnoticed, for the most part.

Unhappily, it is usually the exception that makes the headlines. Some businessmen, either through naivete or laxness, operate with aloofness. These men display a parochial North American outlook that disregards local customs and problems. They often believe that because they are citizens of the United States they are well-liked automatically.

In either case, frictions that ignorance or indifference can create may prove irreparable. In certain foreign areas such practices can destroy good will that other companies have spent years building up.

A Case in Point. Take the case of an American steel company operating in Mexico, for example. When the time came to dedicate the company's new plant, the firm made an advance announcement to the New York press to get what it considered necessary newspaper coverage. A plane-load of New York reporters were flown to Mexico City to attend the ceremonies. They were wined, dined, and finally flown home. Then, sometime later, someone happened to remember the Mexican press.

Executives get solid experience by exchanging ideas on a problem assigned by BCIU.

Invitations were quickly typewritten and mailed to representatives of the Mexican press, asking them to attend another dedication ceremony. To the company's chagrin, not one was accepted. Understandably, the Mexican newspapermen felt snubbed at not being invited along with the American reporters, and let it be known that their dignity had been affronted. The plant, after all, was in Mexico, but the company had chosen to all but ignore its Mexican interests.

Often, companies go about their business in foreign countries just as they would have done at home—with best intentions. They seem unaware that different circumstances call for different handling and different methods.

The Time Element. Take the matter of time, for example. To Americans, time is money. But to millions of people—particularly among the Middle East countries and the Orient—it is nothing of the sort. In some countries, what would amount to a 10-minute business transaction in America may require hours of preparatory small talk or even an elaborate banquet. In the United States, businessmen probably take care of numerous such transactions over the telephone every day.

In certain areas, mistakes by American businessmen may jeopardize the delicately balanced diplomatic position of the United States there. In the light of recent world events, it seems hardly necessary to stress the need for American representatives to constantly demonstrate understanding and friendship toward their host countries.

Foreign attitudes toward us can weaken or strengthen the position of government and business abroad. Because of this, former President Eisenhower in 1955 asked a key group of corporate and government leaders to meet and decide what actions industry might take to help remove misconceptions abroad and help build positive understanding. One result of this meeting was the organization of BCIU. Four years later came the introduction of its Training Program for International Business Executives.

In the fall of 1959, the BCIU's Training Program, administered through The American University's School of International Service, was begun to strengthen company foreign operations. The program was developed by the BCIU Committee on Training, headed by Texaco Board Chairman Augustus C. Long—also a member of the Council's Policy Board.

Under the chairmanship of Charles M. White, chairman, Republic Steel Corp., the BCIU Policy Board membership now includes top executives from 24 leading U.S. corporations that have big capital investments abroad.

The Vice President Speaks. The wisdom of President Eisenhower's request was underlined by former Vice President Richard M. Nixon, who experienced violent anti-American demonstrations throughout his tour of Latin America in 1958. At a luncheon held shortly after his return, where the nucleus of the BCIU Policy Board was formed, the vice president warned, "If we are to meet effectively the total effort the Communists are making in the non-military area . . . our efforts must be total . . . this means not only government, diplomatic, military, and economic teamwork, but it means that the great private segment in our economy—which in many cases, makes the

major impact abroad—must take the major share of this responsibility."

The responsibility Mr. Nixon spoke of is a great one. A wave of nationalism is sweeping through many foreign countries. Open distrust, new and restrictive governmental regulations, and increasing social obligations face American enterprises overseas.

With the possible exception of Western Europe, a growing number of foreign governments have shown willingness to risk economic chaos under nationalism rather than continue ventures supported by American capital and technical skill. Often this attitude is due to Communist activity. The Kremlin is always ready to support a nationalistic group in its battle for "freedom" against capitalistic oppressors." But too often the attitude is due to American inactivity —or indifference.

How to Stifle Apathy. It is this stigma of inactivity or indifference that the BCIU Training Program hopes to remove. The four-week BCIU course (an optional two-week intensified language study is available for executives whose language needs must go beyond basic conversational necessities) is based on the assumption that five elements—in addition to technical competence—are important in preparing executives to take their place overseas:

- First, the ability to quickly, skillfully, and affirmatively understand the people of other countries.

- Second, the ability to interpret many aspects of American economics and culture, particularly those elements in American life which are often misunderstood or misinterpreted abroad.

- Third, an elementary speaking knowledge of the country's language. The more fluent the better.

- Fourth, a practical concept of actual business, social, and domestic situations that are likely to be encountered in various countries.

- Finally, during the last week of the course, the wives of the executives join the group. They hold sessions on family life, social relations, and household management in a foreign setting. An important point often overlooked is that a community-conscious, courteous, and adaptable wife may well be an international executive's most valuable asset.

These five broad objectives form the groundwork of the program's operations. The responsibility of interpreting them into a workable curriculum lies with Training Program Director Harold M. Randall. He is a former career U.S. Foreign Service Officer and U.S. representative to and chairman of the Inter-American Economic and Social Council of the Organization of American States with Ambassador rank. Mr. Randall works directly with Dr. Ernest S. Griffith, dean of The American University School of International Service.

Enrollment Policy. Although five courses are scheduled annually, enrollment is limited to 25 executives for each course. This enables each trainee to receive careful, personalized guidance. The course is especially for administrative, technical, and advisory executives preparing for international assignments at home and abroad. Several participating companies bring home the most promising of their foreign-based executives to take it.

Quite a few companies also bring managers of their various foreign operations (who frequently are nationals of those countries) to the United States. They are put through the course, and sent back better equipped to assume higher echelon positions later.

BCIU feels that effective management of international business operations is achieved through analysis of the political, economic, and social practices of other countries. Thus, the course helps executives improve knowledge of the customs and language of the country with which they will deal.

At the same time, these businessmen learn much about their own country, too. Executives are briefed on American history and hear expert observations on foreign assessment of the United States. They study our foreign policy, the image of America abroad, and the U.S. Mutual Security Program. They are told of current trends in international communism; listen to talks on American civilization, and discussions of cultural relations, communications, and sociological change.

Specialized Curriculum. Since participants work in groups geared to the area of their prospective assignment or special interest, a separate curriculum is offered for each of the following areas: Latin America, Western Europe, Middle East, Far East, and South and Southeast Asia. A special curriculum is made up to cover certain specialized areas, such as Australia, Africa (south of the Sahara), and countries like the Philippines or Israel which differ markedly from others in the area.

The special program offered to wives, whose attitudes and behavior can greatly influence the success of their husbands' work in foreign areas, is held during the course's final week. Wives are given orientation talks that cover a variety of subjects with which they will have to deal. They learn why the program is needed; discuss American foreign policy; analyze cultural differences around the world; improve their knowledge of American

About the Author

King

Kerryn King is vice president and assistant to the chairman of the board of Texaco Inc. Holder of a B.S. degree in journalism from Southern Methodist University, he joined Texas Power and Light Co., Dallas, in 1939 as assistant to the vice president. In 1942 he went with Consolidated Vultee Aircraft Corp.'s Public Relations Department, Fort Worth. In 1943 he joined Hill and Knowlton, Inc., New York public relations counsel, became a vice president in 1947, and senior vice president in 1952. Mr. King joined Texaco as director of public relations in 1953. He was appointed assistant general manager of the Employe and Public Relations Department in June, 1957, general manager three months later, and was elected vice president in charge of that department in 1958. In 1960 he assumed his present position.

institutions—political, social, economic, and cultural.

Through invitations to some of Washington's many international gatherings, the wives learn something of the role of an international hostess. Chats with women who have returned from abroad, or who are familiar with the areas to which they will be going, give them valuable tips on how to establish a household, make social contacts, entertain, and contribute to community life.

Obviously, the BCIU program cannot give a man and his wife answers to all the problems they will encounter while working and living overseas. What it attempts to do is start them thinking in the manner of the foreigners with whom they will be dealing. As one participant put it, in his evaluation of the program at the completion of the course, "This training has really started us talking the language, both literally and figuratively, of those with whom we must deal overseas. It could mean the end of the overseas misfit."

With annual enrollment limited to 150 executives, the BCIU program can fill only a small part of the business community's need for broader understanding of international affairs. But a start has been made, and there are others. The annual Maxwell Institute on American Overseas Operations at Syracuse University, and the Foreign Trade School at Phoenix, Arizona, are examples. At the graduate student level, there are several others such as the language and area study centers at Johns Hopkins and Stanford Universities.

At a time when the nations of the free world are rebelling against every form of colonialism, there is no room for the bumbling businessman, government official, tourist, or any other representative of the United States on the foreign scene.

This is a cause of the utmost importance both to the individual company—whose stake in the ultimate outcome is growing larger every day—and to the nation as a whole. It is certainly something that deserves the active support and constructive participation of every serious-minded executive. After all, it is our own future that hangs in the balance. **The End**

Computers Move into Compressor Station

Continued from Page 54

sure that the change is not a temporary one that will settle down to within the existing operating range within one-minute time. After an engine is added or taken off the line, a 15-minute time delay is provided to allow the line conditions to stabilize before the speed signal is again sensed.

The circuits are arranged so that no matter how large the change in load occurs, the engine start-up or shutdown will operate on the basis of one at a time with the above mentioned time delays between each operation. This is desirable in order to provide the minimum line condition change at a time.

Because of the necessity of overhauling engines from time to time, and since there may be shutdowns because of mechanical failures, a preferential order for operating the various engines must be established. This is provided for by engine starting sequence selector switches on the station cabinet. The position of the selector switch for any individual engine indicates its position in the starting sequence order. Shutdown sequence is in the reverse order. In other words, the last engine started is the first engine stopped when a shutdown is called for.

Circuitry is provided so that if two selector switches are placed in the same position, a one minute alarm timer is energized. This will inform the operator that he has made a false manipulation calling for two engines to start in the same position of the sequence. Any engine may be locked out of service for maintenance by placing its sequence selector switch in the zero position.

Elapsed running time meters are provided for each engine to record the number of hours since last overhaul. This facilitates equalizing the service of the engines.

Another Method of Exercising Similar Control. A recently developed computer system which also holds great promise in this field will be installed on a system soon. (See accompanying photographs). It accomplishes similar results in the following manner:

The analog computer receives the suction and discharge pressures and computes the compression ratio. From this it computes the Bhp/MMcf and derives the volumetric efficiency as a function of a particular pocket setting. This comes out of the computer as a current with the value of the proper logarithm. It is fed into a comparator which compares the computed torque—which is a component of the volumetric efficiency—with the rated torque.

If the computed torque exceeds the rated torque, the computer causes one pocket to open on all compressors. (In this particular installation, the units have 10 pockets, but only 5 of them are automatically controlled). The computer performs the computations for clearance pockets every 5 minutes. Thus, if an engine is operating in a cyclic range, the opening and closing of a single pocket per unit every 5 minutes will not greatly affect engine wear or maintenance.

Actually, the computer comprises only a small portion of the instrument system shown in the accompanying photographs. The telemetering and engine start-up and shut-down sequencing equipment makes up the bulk of the circuitry housed in the cabinets—at both the dispatcher's office and the satellite compressor station. One of the prime objectives of the control system is to enable the dispatcher to start, stop engines, to change discharge set points, etc.

The editors of PIPE LINE INDUSTRY hope to publish a more comprehensive report on this equipment in the near future.

Computers will be more common in the future. Several companies have entered this field with cross-bar switching computers, and several other companies are coming out with prototype units for compressor stations in the near future. —**The End**

ACKNOWLEDGMENT

Drawings and some text material from a paper by William Haley, Union Switch and Signal, Division of Westinghouse Air Brake Co., presented at the 1960 Southern Gas Association meeting, Galveston, Texas. Photographs courtesy of International Controls, Inc. of Houston.

Ideas for the Future

By Donald M. Taylor, Engineering Editor

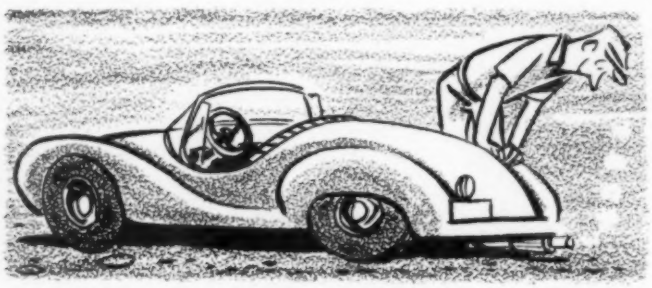
1,000 bits/sec telemetering to feed into system computer

Between August and October two companies plan to market high-speed supervisory control and digital telemetering equipment especially designed for pipe line applications. The speed of transmission will be limited only by the communications circuit. A reasonable cost communications channel will accept 1,000 to 1,200 bits per second, and this will be the speed of the equipment.

How will this be used on pipe lines?

At least one gas company is planning to use the new equipment to initiate continuous scanning of its pipe line system. From one end of the system to the other, readings from instruments will pour into a central computer which will keep tabs on flow, line pack, horsepower requirements, engine efficiencies, sales and purchase meter readings, etc.

This is a step forward toward a truly automatic system. Other manufacturers are said to be designing similar equipment.



Anti-smog auto muffler race nears the finish line

California's dazzling prize that rivals the gold-flecked streams of five score and 10 years ago may soon be plucked from the cautious fingers of the California Motor Vehicle Pollution Control Board. Arvin Industries of Columbus, Ohio, has made application for Step I testing of a catalytic muffler which can convert exhaust gases into carbon dioxide and water. Universal Oil Products is also in the race and has made a similar application.

What is the prize? It's the right to sell anti-smog mufflers to motorists who will be required by law to purchase them; and if my slide rule reads correctly, this could be classed as a strong financial position.

Print all company records on paper size of a postage stamp?

A new super camera developed by the Bureau of Standards is capable of projecting line patterns as fine as 50,000 lines per inch. The purpose of the camera is to test the resolving powers of photographic materials.

The tremendous information storage capacity of high-resolution materials was demonstrated by using this camera to copy the first page of Genesis from the Bible. It was reproduced on an area the size of a *small* bacteria. This is so small that if the entire Bible were reduced to the same scale it would cover an area about the size of the tip end of an ordinary pencil eraser! Yet the copy is clearly legible when viewed through a high-powered microscope.

For pipeliners, this can mean improved aerial photography—we can view the individual blades of grass and grains of sand on a right of way if we want to; what's more, we will perhaps be able to store *all* company records on a piece of photographic paper the size of a postage stamp!

Resources outlook encouraging

"WE'VE ONLY SCRATCHED THE SURFACE OF POTENTIAL RESOURCES" says Dr. Richard J. Gonzalez, well-known economist with Humble Oil & Refining Co. Speaking at Stanford University's School of Mineral Sciences, Gonzalez pointed out that America's use of minerals (including fuels) has about tripled on a per capita basis during this century. He predicts a similar growth for the rest of the world during the next 50 years.

He pointed out that the average U.S. employe in manufacturing, works with about $15,000 worth of equipment with the energy equivalent of 244 men.

Fears of using up energy in the foreseeable future are groundless according to Gonzalez and "underrate the ingenuity of the human mind. Developments to date suggest that we have only scratched the surface of potential resources."

Research on plastic container about the size of a small germ

Scientists have packaged substances in capsules about 0.00004 inches in diameter—about the size of small bacteria—according to Stanford Research Institute. Essentially, the process is based on depositing a polymer film around a material to be "micro-encapsulated".

Stanford, which is doing research on the process for National Cash Register Co., predicts that the uses will be widespread. For example, the capsules make it possible to keep two or more mutually reactive substances physically separated even though they are intimately mixed. Uses so far have been far ranging. Gases, crystals and liquids have been encapsulated as catalysts for chemical reactions, injection into the blood through hypodermic needles, etc.

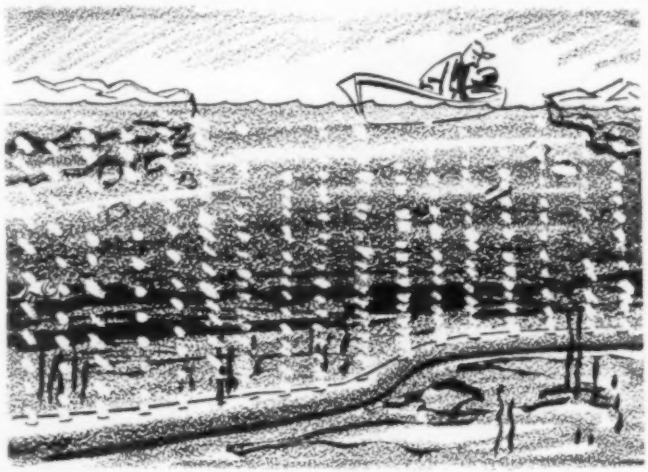
In the future, this process may open up new fields for pipe line transportation. Finely divided substances could be encapsulated, injected into a crude or products stream and removed at a destination.

Utility companies join in speeding MHD research

The Avco Corp. and a number of utility companies have joined forces to speed research on MHD (Magnetohydrodynamic) generator.

The process is based on heating gas to 5,000° F and passing it through a magnetic field to generate an electric current. No mechanical drives or moving parts are necessary and the over-all efficiency of the system will be high according to early research findings.

Avco and the utility companies will spend $1.2 million on research this year.



Underwater lines can keep northern streams free of ice

Underwater bubbler systems that release compressed air near the bottoms of still waters where ice forms will probably be used to free parts of the St. Lawrence River from ice packs which block navigation in winter.

When the air is released under water, it brings warm water to the surface. This keeps the water free of ice—even in severe climates. Proof of the efficiency of the system can be found in Sweden where a 4½-mile-long bubbler system keeps the surface of Lake Malaren free of ice all winter long. Normally, the ice would be 20 inches thick.

Ice jams can be prevented by impounding surface ice outside the navigation channels and by preventing the breeding of frazil ice (turbulent water ice that cements floes together). But once a jam starts it will grow rapidly —ice jams near Montreal have been known to reach a thickness of 90 feet over the winter's span.

Engineers estimate that two 16-mile-long floating booms with a bubbler system suspended underneath could keep Lake St. Peter near Montreal free of ice. They predict that year-round navigation will be extended all the way to Lake Ontario by 1980.

Zinc oxide has four times piezoelectric effect of quartz

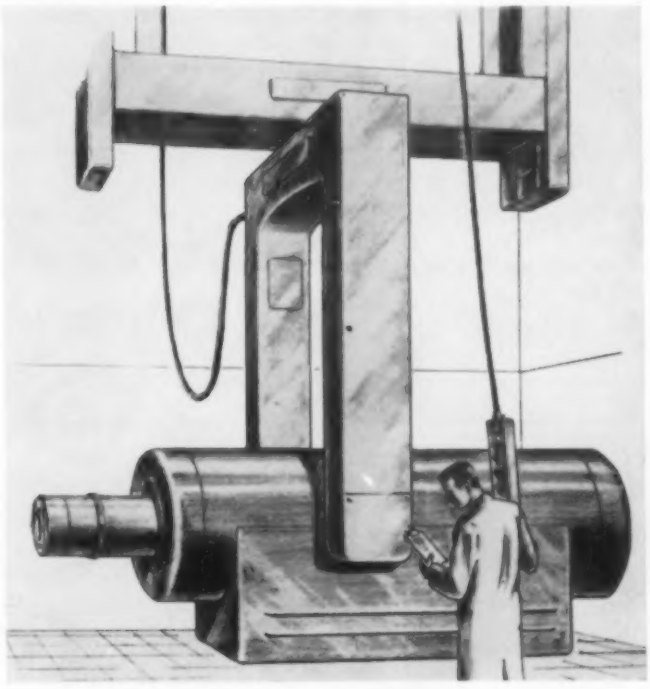
Right now when many researchers are working with piezoelectric effects—(remember "Spark Pump" etc. when a crystal is twisted it produces electrical current.) the Bell Telephone Laboratories has discovered that common zinc oxide exhibits a four times greater effect than quartz. However, the zinc oxide must first be "doped" with lithium to neutralize the excess conductivity effect which until now has masked this effect.

Lead and plastic make high-strength putty

A lead and plastic putty which can be applied with a trowel, yet sets up as a high strength filler has been developed in England. Composed of 94 percent lead and six percent thermosetting plastic, the compound can be worked when soft, yet it becomes rigid in three hours after application of a hardening agent.

Thermoelectric generators for gas-burning furnaces

A development program aimed at producing built-in thermoelectric generators which can supply current for boiler plant auxiliaries is the objective of Minnesota Mining & Mfg. and a group of gas utility companies. According to 3M, this will mean a savings in installation and operating costs for gas furnace users, making them independent of outside power.



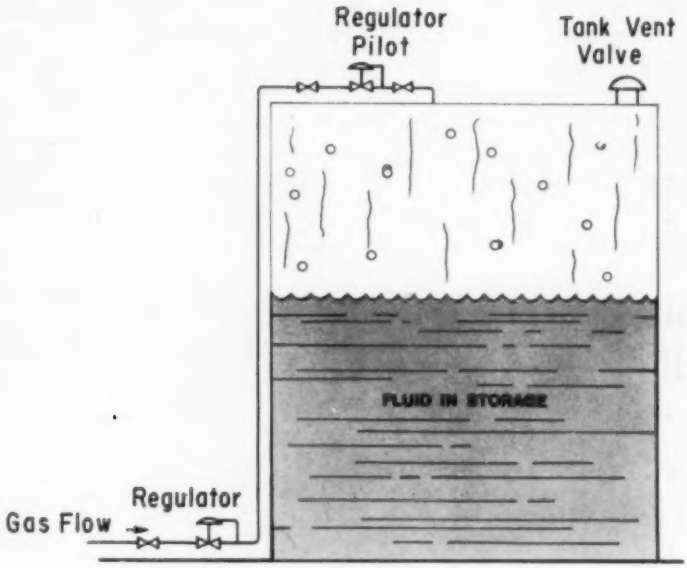
Powerful X-Ray Machine will 'See' through 16 Inches of Steel

The world's most powerful X-ray machine, an eight-million electron-volt accelerator now is being built for the A. O. Smith Corp. to produce 6,000 roentgens per minute. This is sufficient to X-ray 16 inches of steel at a distance of nine feet in 18 minutes. Clarity is sufficient to pick up hidden flaws in the metal.

How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas



Gas Blanket Reduces Product Losses in Tankage

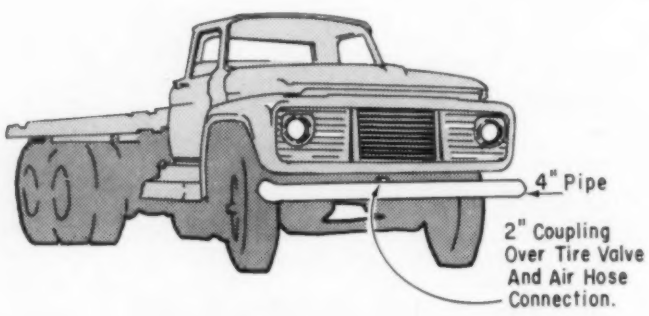
A gas blanket above the product in storage tanks can reduce product losses and the explosion hazard as well.

A slight gas pressure on the tanks prevents air breathing that normally comes with temperature changes. When temperature falls, a very sensitive gas regulator adds a volume of gas in top of the tank. Every effort is made to keep the gas blanket stratified, and when the tank exhales, the dry gas in top of the tank is, of course, the first to go.

The pilot regulator is made especially for gas blanketing. It is designed so the main valve in the regulator opens wide when outlet pressure decreases to 0.3 inches of water. The valve closes when the pressure reaches 0.5 inches of water.

Summed up, the advantages of the new system are three-fold. First, gas eliminates corrosion by preventing the gathering of moisture inside the storage tank via air; second, it prevents product contamination by acting as a shield against the atmosphere, and, third, it maintains positive pressure on the tank during pump-out periods.

Photo—Courtesy Rockwell Manufacturing Co.



Air Supply for Maintenance Truck

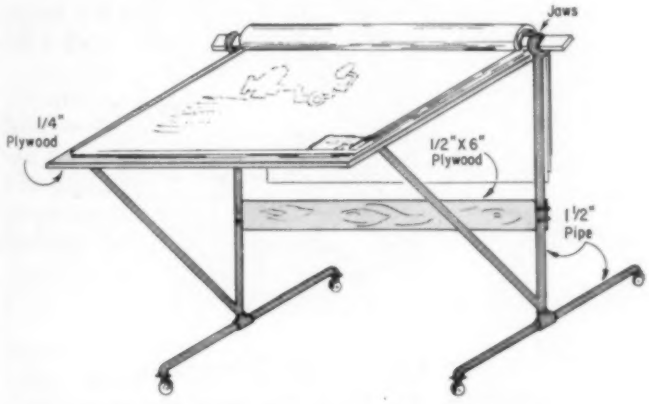
Many pipe lines lie in remote areas where service stations for trucks and pick ups may be 50 to 100 miles distant. The pipe line maintenance man in such areas must take the Boy Scout's motto—"Be Prepared"—very seriously.

Here is one step in this preparedness. Close the ends of the pipe used for the headache rack or front bumper and carry a supply of compressed air. Many maintenance trucks have bumpers made of four-inch pipe, and if the ends are bull-plugged, it will hold enough air to fill a tire or to blow out a carburetor, etc.

To make this "storage bottle," tap the pipe for a valve stem of the size found on heavy-duty truck tires or tubes. This will be used for filling the pipe. Also, tap the pipe and make up a quick-made hose connection—for a hose similar to those used in service stations. The hose, which can be purchased at any service station supply, should be long enough to reach all tires and it should have a blower connection similar to those used in service stations. This makes it possible to blow out clogged gas lines, etc. Weld a nipple over two fittings to protect them.

A-Frames Facilitate Handling Materials

One station maintenance foreman uses an A-frame mounted on back of his pick-up truck to handle material and load parts too heavy to facilitate by hand. A heavy bumper made of channel iron replaces the standard bumper and a clevice in each end is used to hold the bottom of the boomers. The boomers lay down on a headache post above the cab and are easily erected and pinned together with a hook that holds the sheave. A winch mounted on the side of the headache post is used to provide the power for hoisting the material.



Mount Drawings on Stand At Station Fabricating Shop

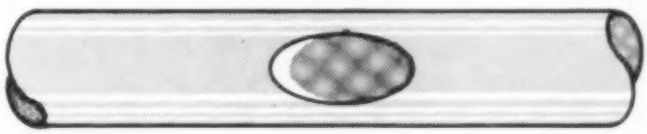
Fabricating headers and piping for pipe line stations requires a high degree of precision. The only way to achieve it is to follow the drawings closely and to do careful work. This somewhat bulky, but highly useful blueprint rack will make it easier for the fabricator to have the drawing he is using readily available—much handier in fact than having it folded in his pocket.

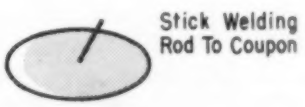
The stand is made of 1½-inch pipe with four casters for easy movement. The upright members can simply be screwed into the collars on the base; of course, the jaws for the stick of drawings must be aligned as shown.

The desk part of the rack can be made of ¼-inch or ½-inch plywood. The entire assembly can be demounted for shipment to the next job.

Make Pump Hook-up Units Simple for Mobility

Where pipe line pumps are apt to be moved many times, some thought should be given to making the piping as simple as possible. On this pump, the by-pass on the left and the relief valve, at right, are set between the intake line on bottom and discharge line on top taking up minimum space on the skid-mounted unit. This allows space for the fuel scrubber and regulator on the side so that when the unit is spotted, it is necessary only to connect up the fuel and intake and discharge lines which are all side by each.

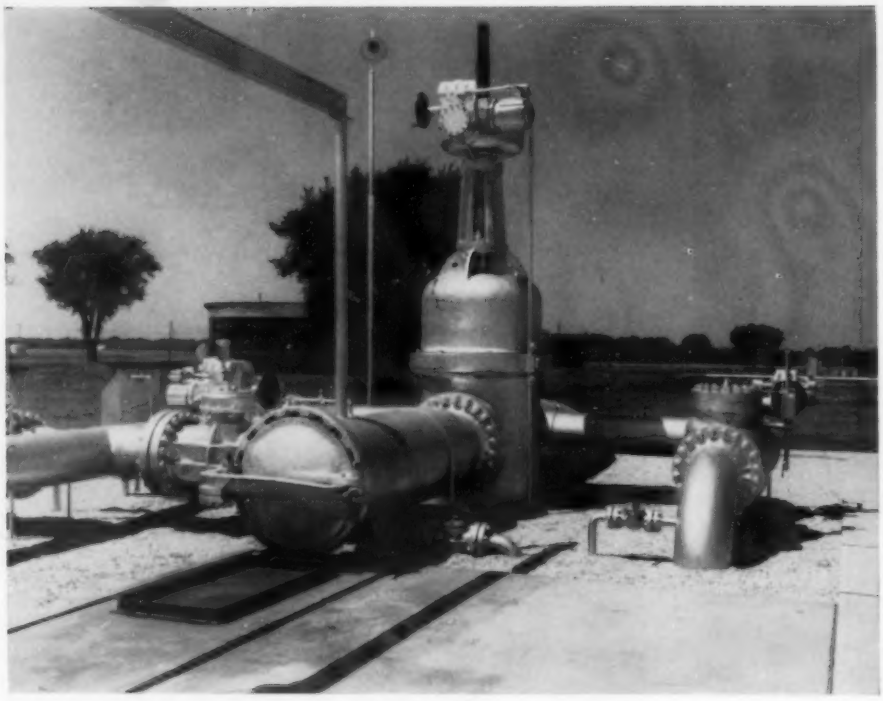




How to Repair a Leak On Inaccessible Line

There are times when leaks develop in pipe lines right up next to concrete abutments, bridges etc. Here is one approach to such repairs which has proved successful in the past—however it is not recommended for high-pressure pipe lines.

Simply cut a window in the pipe on the accessible side away from the leak. Weld up the leak from the inside of the pipe. Bevel the pipe window, make the window and weld it back in place.



Sump Contamination Reduced At Pump Station Scraper Trap

The depressed section of platform in front of an incoming scraper trap that drains off surplus oil brought in by the "pig," is not always desirable; it serves to collect and flow rainwater into the sump, complicating the separation problem.

Here is how one pipe line eliminated this contamination; by making the deck at the scraper trap level, without a sump or opening to the waste oil collection unit and instead using a sturdy steel "drip" pan. It is long enough to accommodate the pig when received and collects any drip from the pig while supported from the overhead trolley.

After the scraper is removed the pan may be drained into the sump. When not in use the pan may be turned over to avoid collecting rainwater. By admitting air at the top of the barrel and waiting for a few minutes after scraper arrival, the drain pipe takes off all but traces of the fluid, so the pan rarely catches much oil, even though the scraper might be clogged with paraffin.

Put a Wooden Handle On an Allen Wrench

This takes a bit of lathe work, or a considerable amount of whittling.

Shape a wooden handle—one way or the other—and drill it about the same size as the wrench stock. Add cement and insert the long leg of the wrench.

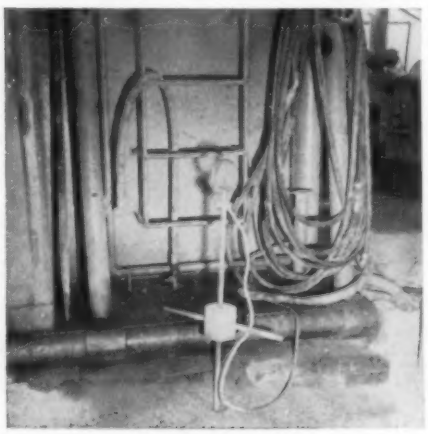
The convenience of the handle for certain uses is downright exciting. Of course, there are applications where a handle will hinder the work. But the wrenches are so cheap that an extra set should provide the answer to this problem.

Construct Dew Point Tester Stand from Scrap Material

This dew point tester stand was constructed of scrap 1-inch pipe and a 10¾-inch casing thread protector. The thread protector is used as a base for the coolant gas bottle. By installing the gas bottle upside down on the thread protector, the operator is assured of utilizing all gas in the bottle.

The dew point tester is installed on the same stand as the bottle for maximum convenience. With both bottle

and tester installed on the same unit the stand can be moved with ease to any desired point.



Use Built-In Hammer To Sink Ground Rod

Time and effort involved in rigging the light plant can be saved by equipping the ground rod with a built-in hammering device of the type illustrated. On the rod, and spaced about 18 inches apart, are welded two stops. The handle-equipped weight, working between the stops, is slammed down hard on the lower one a few times to sink the rod and, to remove it, is brought up hard against the upper stop.

The ground wire is attached to the rod between the top stop and the heavy ring handle. The unit is easily carried and stored inside the light plant house between moves.

WHAT'S HAPPENING IN PIPE LINE CONSTRUCTION

By **Donald G. DePugh,** Construction Editor

Northern Gas Products Company Plans 350-Mile, 8-Inch LPG Line

Northern Gas Products Company will construct a 350-mile, 8-inch LPG line from Bushton, Kan., to Des Moines, Iowa, to tie into the Great Lakes Pipe Line Company system which extends into Minnesota and Illinois. Great Lakes existing system will be converted from a products line to an LPG carrier.

Northern Gas Products, a wholly owned subsidiary of Northern Natural Gas Company, is building a natural gas liquids extraction plant at Bushton which will supply the proposed line.

The latest in a surge of liquefied petroleum lines, the new system will have an ultimate capacity of 40,000 barrels per day and will serve seven terminals between Bushton and Minneapolis, St. Paul and Chicago. Including the extraction plant, the project will cost $12 million.

Northern Gas Products will construct seven terminals on the overall system; three on the new line and four on Great Lakes 6-inch system. Terminals will be located at Bushton, Kan.; Plattsmouth, Neb.; Des Moines, Mason City and Iowa City, Iowa; Rosemount, Minn., and Prophetstown, Ill.

The line will serve industrial and domestic customers in the midwest area. Phillips Petroleum Company has signed a contract for purchase of propane at all the terminals. Construction of the line is expected to get underway soon.

Tennessee Gas Plans To Purchase Offshore Gas

Tennessee Gas Transmission Company has filed with the Federal Power Commission seeking permission to purchase natural gas properties offshore from Louisiana.

Tennessee would buy properties from Socony Mobil Oil Company, Continental Oil Company and Newmont Oil Company for $68 million. TGT still seeks authorization to construct and operate facilities to transport gas from these Cameron and Vermillion blocks to its main line. This application was originally filed in 1958.

United Gas Lets Contract to Zachry

A contract has been awarded to H. B. Zachry Company by United Gas Pipe Line for construction of 22 miles of 24-inch gas line in Texas. The line extends from Satsuma to Sugar Land.

Montana Power Lets Contract to Majestic

Majestic Contractors, Inc., has been awarded contract by Montana Power Company for 56 miles of 16-inch gas line. The line extends from Cut Bank, Mont., north to the United States-Canadian border. Also a 4-mile, 16-inch line will be built by Majestic for Canadian-Montana Pipeline Co., a susbidiary.

Service Pipe Line Lets Contract for Crude Loops

Service Pipe Line Company has awarded a contract to River Construction Corporation for construction of 60 miles of 12-inch loop lines to increase capacity on its LaPlata, Mo., to its Wood River, Ill., crude line. Capacity of the 250-mile system will be boosted from 77,000 to 97,000 barrels daily.

Pipe Line Reservoir Crossing

Service Pipe Line Company is laying a 1-mile crossing consisting of four crude lines under the proposed Keystone Reservoir, now under construction on the Arkansas River in northeast Oklahoma. Williams Brothers is installing a 16-inch, two 12-inch and lowering an existing 20-inch line for Service. At left, welders make hot pass of 16-inch line. Sandpoints to carry subsurface water out of ditch across the bed of the reservoir are inserted at right.

Houston Texas Gas & Oil Application Receives OK

A Federal Power Commission examiner authorized the Houston Texas Oil & Gas Corporation and Coastal Transmission Corporation application for construction of pipe line facilities costing about $23 million.

The decision is subject to full commission hearing. Houston would build $16 million in facilities to increase its capacity by 93 MMcf of gas daily. It includes construction of 235 miles of sales laterals and 30,000 horsepower. Coastal's project includes $7.2 million of facilities to up its capacity 97 MMcf daily. It includes about 71 miles of laterals and 12,500 horsepower.

FPC Sets Hearing Date on Application

American Louisiana Pipe Line Company's application will be heard at an FPC hearing April 10. The request amounts to a 25-mile, 8-inch line to connect Holly Ridge field, Tensas Parish, La., with main line.

Northern Natural Lets Contracts on Laterals

Northern Natural Gas Company has awarded contracts on about 1,200 miles of 2 thru 10-inch gas lines. Contractors include Shamrock Construction Co., Brodie Construction Co., Harbert Construction Co., Davis Construction Co. and R. E. Reutzel Co.

Davis has been awarded 125 miles of 2 thru 8-inch for work in South Dakota and Iowa. Reutzel will lay 116 miles of 2 thru 8-inch in South Dakota. Shamrock has 130 miles 2-8-inch in Iowa. The lateral lines will be laid in Iowa, South Dakota and Minnesota.

FPC Natural Gas Pipe Line Map Issued

The Federal Power Commission announced that its revised Major Natural Gas Pipe Lines map is available. The new map is complete through December 1960, and supersedes the June 30, 1960, issue.

The map includes all major gas lines completed, under construction or pending FPC action. It is available from the Federal Power Commission Washington 25, DC., at 25 cents per copy. Order number is FPC-M-60.

Plains Pipe Line Plans 70-Mile Line

The Public Service Commission of Wyoming has received an application from the Plains Pipe Line Division of Franklin County Coal Corporation seeking permission for a crude system in Wyoming.

The 70-mile, 10-inch crude line would extend from Fiddler Creek Station in Weston County to the Lance Creek oil field in Niobrara.

Transco Authorized to Build a Bypass Loop

Transcontinental Gas Pipe Line Corporation has been authorized by the FPC to lay a loop to bypass a hydroelectric project being built in North Carolina.

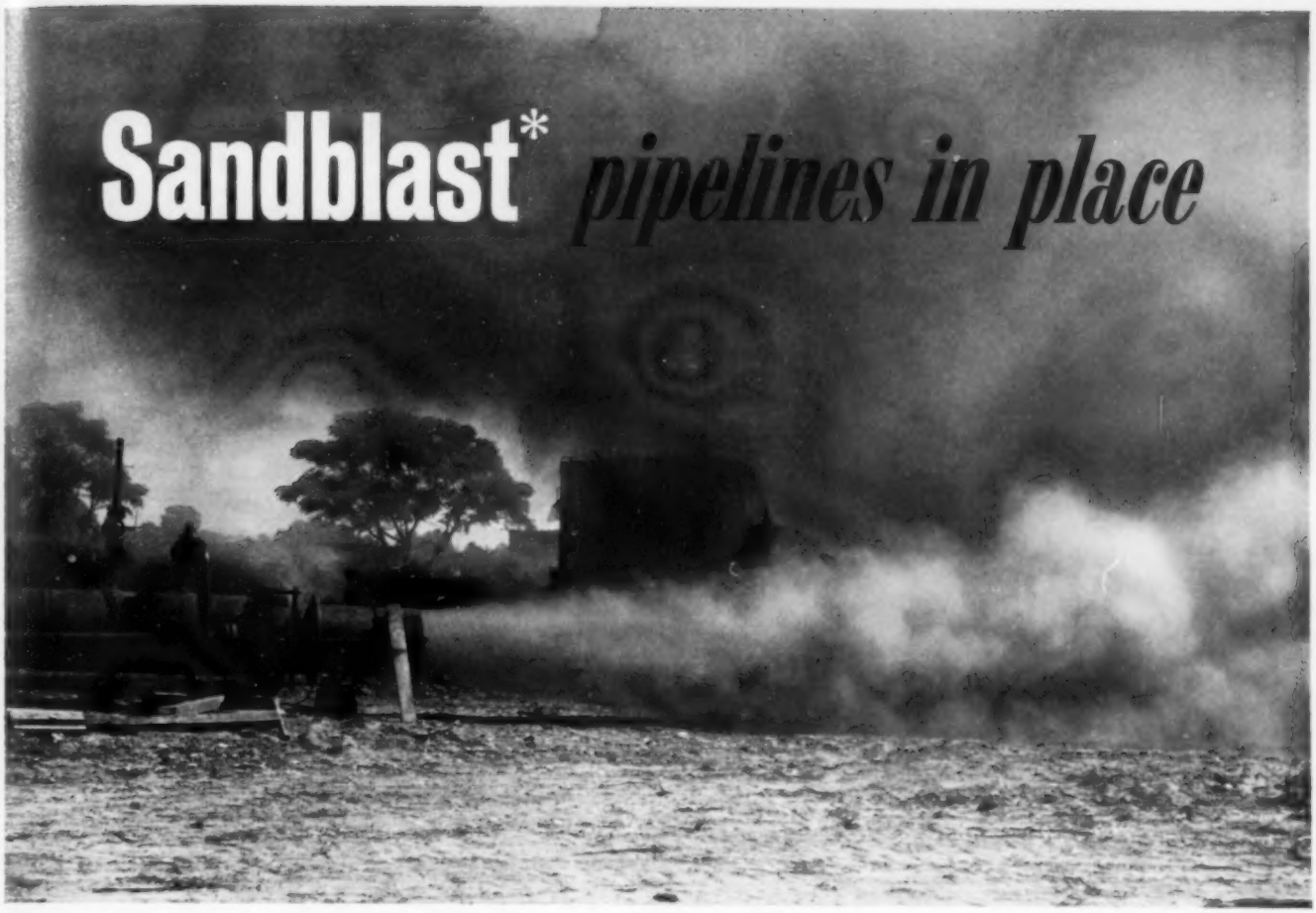
Transco's work includes about 15 miles of 36-inch main loops, adding weights to existing loops and relocate a water pumping station. It's a $2.8 million project.

Colorado Gas Plans 250-Mile, 20-Inch Line

Colorado Gas Transmission Company plans a 250-mile, 20-inch, natural gas line in Colorado. The system would extend from Ignacio-Blanco area in southwest Colorado to Walsenburg, Pueblo and Colorado Springs. The company has filed with the Colorado Public Utility Commission requesting authorization.

Willett Awarded Stringing Contract

United Gas Pipe Line Company has awarded a contract to J. O. Willett Pipe Line Stringing Company for unloading pipe at various locations in Louisiana. Willett will unload 51.3 miles at Tioga, 60.1 miles at Loreauville and 59.4 miles at Columbia.



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PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U.S.

Algonquin Gas Transmission Co., Boston, 25 miles, 20-inch; 8 miles, 8-inch, gas, and 12,000 hp addition in Massachusetts, $6 million, approval FPC.

Arkansas Louisiana Gas Company, Shreveport, La., 58 miles, 2-6-inch, gas, planned.

Belle Fourche Pipeline Co., Casper, Wyo., 103 miles, 8-inch, crude, Fiddler Creek field to Lance Creek, Wyo., and branch lines from North Donkey Creek field to Rozet and Miller Creek fields, $2¾ million, approved by Wyoming Public Service Commission.

Border Gas Transmission Company, 300 to 400 miles, gas, gathering, in South Texas, $10 million, planned.

Buckeye Pipe Line Co., New York, 42 miles, 8-inch, products, Flint to Bay City, Mich., $1.7 million, planned.

California Gas Transmission Company, Los Angeles, (subsidiary of Tennessee Gas Transmission Company), 292 miles, 20-34-inch gas, from Mexico-California border near Mexicali, to Los Angeles and 10,000 hp. to tie into Texas Mexico-California line, $50 million, before FPC and California Public Utilities Commission.

Coastal States Gas Producing Co., Corpus Christi, Texas, 60 miles, 10-inch, gas, gathering, La Salle and Frio counties, Texas, before FPC.

60 miles, small diameter, gas gathering line, to tie in with system under construction and extend to Pearsall County, Texas, planned.

Coastal Transmission Corp., Houston, 71 miles, 3 to 10-inch, gas, laterals; 5,500 hp in stations at Port Lavaca, Texas, and Eunice, La., and additional 1,500 hp at Robstown, Texas, $7.2 million, FPC examiner authorization.

Colorado Interstate Gas Co., Colorado Springs, 140 miles, 34-inch, gas, Green River, Wyo.,-to-Provo, Utah; 109 miles, 26-inch, Texas Panhandle to southeastern Colorado, 136 miles, 34-inch, southeastern Colorado-to-Pueblo, Colo.; 107 miles, 30-inch, Pueblo-to-Denver, $91 million, FPC conditional authorization.

Colorado Oil & Gas Corp., Denver, 400-miles, gas, from Gubik field to Fairbanks, Alaska, planned.

Columbia Gulf Transmission Company, Houston, 97 miles, 30-inch, loops in Kentucky, Tennessee, Mississippi and Louisiana; 29 miles, 12-inch lateral in Louisiana, $15 million, before FPC.

El Paso Gas Supply Company, El Paso, Texas, 228 miles, 30-inch, gas, main, Live Oak to Sutton County, Texas, $30 million, before FPC.

El Paso Natural Gas Company, El Paso, 199 miles, 30-inch, Permian-San Juan crossover loop, before FPC.

17 miles, from Pacific Gas Transmission Co. facilities to near Spokane, Wash., before FPC.

34 miles, 20-inch, Puckett to Goldsmith, before FPC.

23 miles, 20-inch, Goldsmith to Eunice-Plains line, before FPC.

9 miles, 20-inch, Goldsmith-Plains loop, before FPC.

43,600 hp in new and existing stations in Texas, Oklahoma, New Mexico and Utah, before FPC.

400 miles, 34-inch, Salt Lake City, Utah, to California border, FPC conditional authorization.

El Paso Natural Gas Products Company and **El Paso Products Pipeline Co.,** 32 miles, 6-inch, crude, from Patrick Draw Oil and Gas field to Wamsutter, Sweetwater County, Wyoming, before Public Service Commission.

Equitable Gas Company, Pittsburgh, Pa., 31 miles, 16-inch, and 26 miles, 20-inch, in West Virginia and Pennsylvania, $5 million, before FPC.

Hope Natural Gas Company, Clarksburg, W. Va., 20 miles, 20-inch, gas, in Lewis, Ritchie and Pleasants counties, W. Va., $2 million, FPC authorization.

Houston Texas Gas & Oil Corp., St. Petersburg, Fla., 235 miles, 2 to 6-inch, gas, laterals; 20,000 hp in five new stations; $16 million, FPC examiner authorization.

Kansas-Nebraska Natural Gas Company, Hastings, Neb., 165 miles, 2-8-inch, gas, extension from Alliance, Neb., to Chadron, Crawford, Hemingford, Hay Springs, Gordon and Rushville, Neb., before FPC.

45 miles, 2-3-inch, gas, in Kansas, approved by Kansas Corporation Commission.

2,000 hp addition at Scott City, Kan., FPC approval authorization.

2,500 hp addition at Holcomb, Kan., before FPC.

Lone Star Gas Company, Dallas, 52 miles, 18-inch, Springtown to Gordon, Texas, planned.

47 miles, gathering lines in Palo Pinto, Erath and Stephens counties, Texas, planned.

Long Island Pipeline Company, New York, 75 miles, 20-inch, products, Linden, N. J., to Long Island, N. Y., $30 million, planned.

Lo-Vaca Gathering Co., 230 miles, 6-20-inch, gas, gathering, Live Oak to Lavaca County, Texas, planned.

Matador Pipe Line Corp., Denver, 175 miles, crude, from Bottineau, Burke and Renville counties, N. D., to Cromer, Man., Canada, $4 million, proposed.

Michigan Wisconsin Pipe Line Co., Detroit.

37 miles, 6 and 12-inch lateral loops in Wisconsin, before FPC.

29 miles, 30-inch, loops, Illinois, Indiana, and Michigan, 3,000 hp. station, Janesville, Wis., before FPC.

Two 2,000 hp units at Meade, Kan., one 2,000 hp unit at Havensville, Kan., before FPC.

Mid-America Pipe Line Co., 405 miles, 10-inch, LPG, Superior, Wis., to Chicago, $12 million, considered.

Natural Gas Pipeline Company, Chicago, 62 miles, gas, pipe line and various river crossings, FPC authorization.

257 miles, 30-inch, gas, loops, $28 million, before FPC.

89 miles, gas, loops, planned.

New Haven Pipeline, Inc., products line, New Haven, Conn. to Springfield, Mass., $2.5 million, planned.

Niagara Mohawk Power Corp., 122 miles, 12-inch, Watertown and Massena, N. Y., contract let to Fulghum Contracting Corporation pending FPC approval.

Northern Natural Gas Company, Omaha, Neb., 236 miles, gas, in Kansas, Nebraska, Iowa, Illinois and Wisconsin and 14,050 hp, $25 million, before FPC.

124 miles, in Oklahoma, Kansas, Nebraska, Iowa, and Minnesota and 17,360 hp, $17 million, before FPC.

22 miles, in Iowa, $673,100, before FPC.

Northern Gas Products Co., (subsidiary of Northern Natural Gas Co.), 350 miles, 8-inch, LPG, Bushton, Kan., to Des Moines, Iowa, $12 million, planned.

Northwestern Refining Co., crude gathering system, Rival and Lignite fields, North Dakota, $625,000, Public Service Commission approval.

Ohio Fuel Gas Co., 59 miles, gas, 4-24-inch main lines, in Belmont, Carroll, Cuyahoga, Fairfield, Logan, Lorain, Marion, Muskingum, Stark and Wayne counties, Ohio, $5.1 million, planned.

Panhandle Eastern Pipe Line Co., Kansas City, 305 miles, 30-inch, 40 miles, 26-inch, gas, loops, and 43,000 hp, and gathering facilities, $60 million, before FPC.

200 miles, 22-24-inch, gas, lateral, from Elk City, Okla., to Haven, Kan., before FPC.

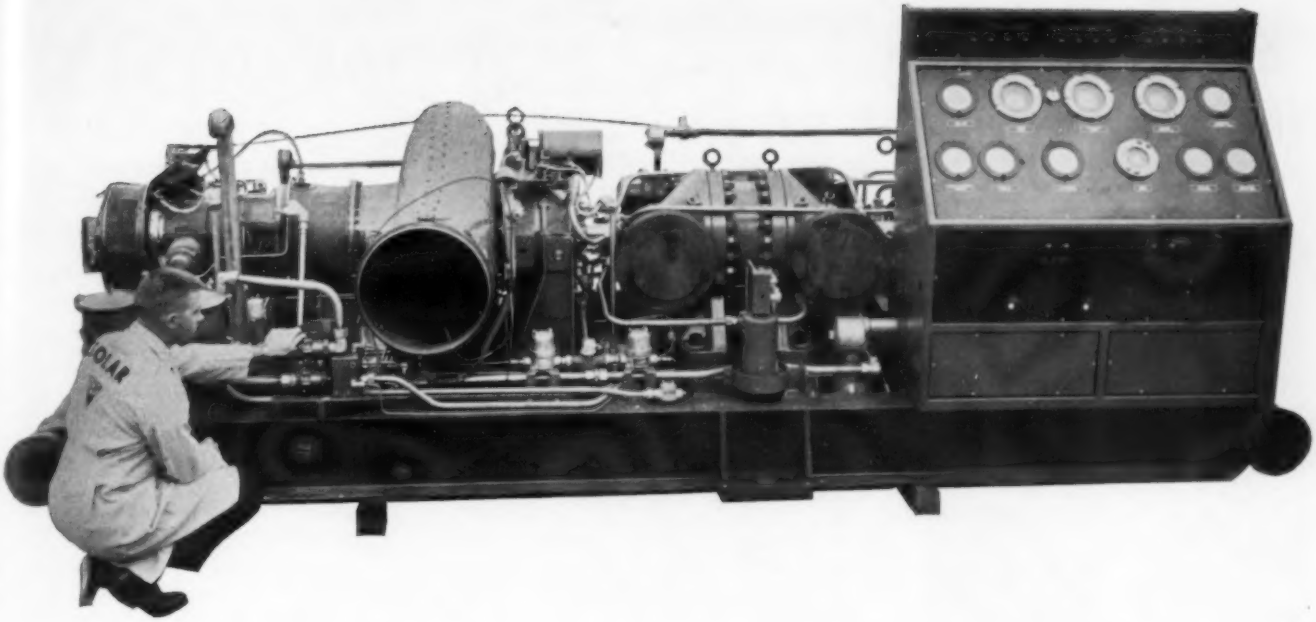
Pan American Gas Company, Tulsa, 50 miles, 12-inch, gas, La Porte to Pasadena to Texas City, Texas, contract let on 32 miles to **Golightly Construction Co.**

Peoples Gas Light & Coke, Chicago, 29 miles, 36-inch, gas between North Shore and Calumet stations, planned.

Phillips Pipe Line Co., Bartlesville, Okla., 75 miles, main line, 85 miles, gathering crude, from Camrick field, Gray, Okla., to Phillips, Texas, planned.

Southern California and Southern Counties Gas Cos., Los Angeles, 93 miles, 34-inch, California-Nevada border to Newberry, Calif.

Continued on Page 76



New Solar gas turbine compressor offers low cost, reliability, easy maintenance

A FUNDAMENTAL ADVANCE in the centrifugal compressor field is available in Solar's new gas-turbine-driven compressor line. These units are particularly adapted for gas compression (both field and main pipeline) and for general industrial use in the low volume range up to 1500 psi.

Long-life gas turbine engines, with rotating speeds of 15,000 to 30,000 rpm, made this breakthrough possible. Driving the compressor directly at turbine speeds has permitted the design of small, high efficiency centrifugal compressors that operate in the range from 75 to 1500 cfm or 5 to 150 MM SCFD.

Features of these compressor packages include: Interchangeable compressor rotors and other parts that allow fast, low cost field changes to meet new flow and pressure requirements. Designed to start and stop in seconds, even by remote control, they are ideal for unattended operation. Small and lightweight, they are easily moved and installed on inexpensive foundations. Maintenance is unusually simple.

Detailed information on Solar centrifugal gas turbine compressors is available. Write to Dept. H-224, Solar Aircraft Company, San Diego 12, California.

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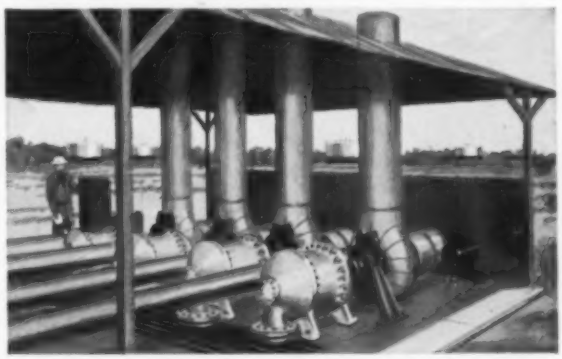

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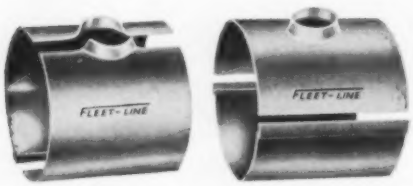

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PROPOSED CONSTRUCTION

continued

St. Lawrence Gas Company, Inc., Ogdensburg, N. Y., 75 miles, gas, main, United States-Canadian border to Ogdensburg, N. Y., $3.4 million, FPC examiner approval.

SunOlin Chemical Company, Philadelphia, 6,000 feet, ethylene line, under Delaware River, Claymont, Penn., to Penns Grove, N. J., $2 million, planned.

Tennessee California Gas Transmission Company, (subsidiary of Tennessee Gas Transmission Co.), 100 miles, 26-inch, gas, gas fields in South Texas to Texas-Mexico border near Reynosa, before FPC.

Tennessee Gas Pipeline Co., Houston 191 miles, 30 and 36-inch loops, in Ohio, Pennsylvania and New York, 72 miles of gathering lines and 43,600 hp in five stations, $46 million before FPC.

158 miles, 36-inch, gas, loops in Mississippi and Louisiana, FPC authorization.

21 miles, 16-inch, 2 miles, 12-inch, gas, Louisiana coast, Vermilion blocks 46 and 64, $3 million, before FPC.

50 miles, 10-16-inch, gas, offshore Louisiana, FPC authorization.

Texas Eastern Transmission Corp., Shreveport, La.

66 miles, 30-inch, gas, loops, between Vidor, Texas, and Lambertville, N. J., and 33,710 hp in four existing stations, $17.5 million, temporary FPC authorization.

165 miles, 20-inch, gas, West Monroe, La., to Kosciusko, Miss.; 128 miles, 30-inch, loops, between Kosciusko and Lambertville, N. J., and 37 miles, laterals in New Jersey, 51,000 hp., $55.2 million, before FPC.

144 miles, gas, 46,300 hp. $27.8 million, for 1962, before FPC.

Texas Gas Transmission Corp., Owensboro, Ky., 96 miles, 26-30-inch, gas loops, Louisiana, Arkansas, Mississippi, Tennessee, Kentucky and Indiana; 50 miles, 8 and 16-inch extension into Terrebonne, La., producing area, $16.8 million, before FPC.

Transcontinental Gas Pipe Line Corporation, Houston.

211 miles, 36-inch, and 69 miles, 30-inch, loops and additional 32,040 hp, in Texas, Louisiana, Mississippi, Alabama, Georgia and South Carolina, $52 million, FPC examiner approval.

163 miles, 36-inch, gas, loops, in Louisiana, Alabama, Mississippi, Georgia, North and South Carolina, Virginia, Maryland and Pennsylvania, 10,500 hp, $30 million, before FPC.

13 miles, 24-inch and 18 miles, 20-inch loops, Louisiana, FPC authorization. 14 miles, 16-inch laterals, 1-mile, 12-inch lateral, Louisiana, $2.1 million, FPC authorization.

29 miles, 20-inch, gas, and 2,500 hp, in South Texas to take gas from South Texas Natural Gas Gathering Co., $2.4 million, FPC authorization.

Trans-Southern Pipeline Corp., Houston, 1,080 miles, 12-inch, LPG, from Mont Belvieu, Texas, to Danville, Va., and 215-mile spur line from Atlanta to Georgia-Florida border, $63 million, planned.

Trunkline Gas Company, Houston, 252 miles, 30-inch loops, and 140 miles, laterals, between Longville, La., and Tuscola, Ill., $45 million. Contracts let on 155 miles to Cape Construction, Western Pipe Line, Panama-Williams, Panama Inc., and Grayco.

United Gas Pipe Line Co., Shreveport, La., 59 miles, 36-inch, gas, lateral between Bastian Bay field and Plaquemines Parish, La., before FPC.

217 miles, 30-inch, gas, Lafayette to Monroe, La., planned.

Union Texas Natural Gas Corp., (joint project with Phillips Petroeum Co., Warren Petroleum Corp. and Tuloma Gas Products Co.) 1,000 miles, LPG, Houston to North Carolina, $35 million, planned.

Valley Gas Transmission, Inc., Houston, 55 miles, 3 to 8-inch, gas, gathering, in Hidalgo, Brooks, Starr and Jim Wells counties, Texas, $15 million, before FPC.

West Shore Pipe Line Co., 250 miles, 10-16-inch, products, East Chicago, Ind., to Green Bay, Wis., planned.

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella Coola, B. C., before B. C. Government.

Ajax Alberta Pipeline Ltd., 28 miles, 10-inch, gas, main, Morinville to Westlock, Alta., planned.

Assistencia de Oleodutos du Petrobras, Rio de Janeiro, 280 miles, 12-inch, crude, Rio de Janeiro to Belo Horizonte, Brazil, planned.

Abu Dhabi Marine Areas Ltd., (British Petroleum Co. and Compagnie Francaise Des Petroles) 20 miles, 18-inch, crude, from Umm Shaif offshore oilfield to Das Island, Persian Gulf, planned.

Barnabos Group (Italian Interests), crude line from Venice, Italy, to Insbruck, Austria, with extension to Munich, Germany, planned.

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

British American Oil Co., Ltd., Toronto, 125 miles, gas, Pincher Creek fields to Calgary, Alta., before Alberta Public Utilities Board.

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, India. Contract let on 250 miles to Mannesmann-Saipem.

Cartier Gas Corp. (St. Maurice Gas, Inc., and Consumers Gas Co., Toronto), 170 miles, gas, Montreal to Quebec City, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Foothills Pipe Lines Ltd., 1,300 miles, LPG, from Alberta-Saskatchewan border to Chicago, tie-in with Westalta Products Pipeline proposed system in Alberta, $100 million, before Alberta Board of Public Utilities Commissioners.

Gas del Estado, Buenos Aires, 1,050 miles, 30-inch, gas, Comodoro Rivadavia field

Continued on Page 79

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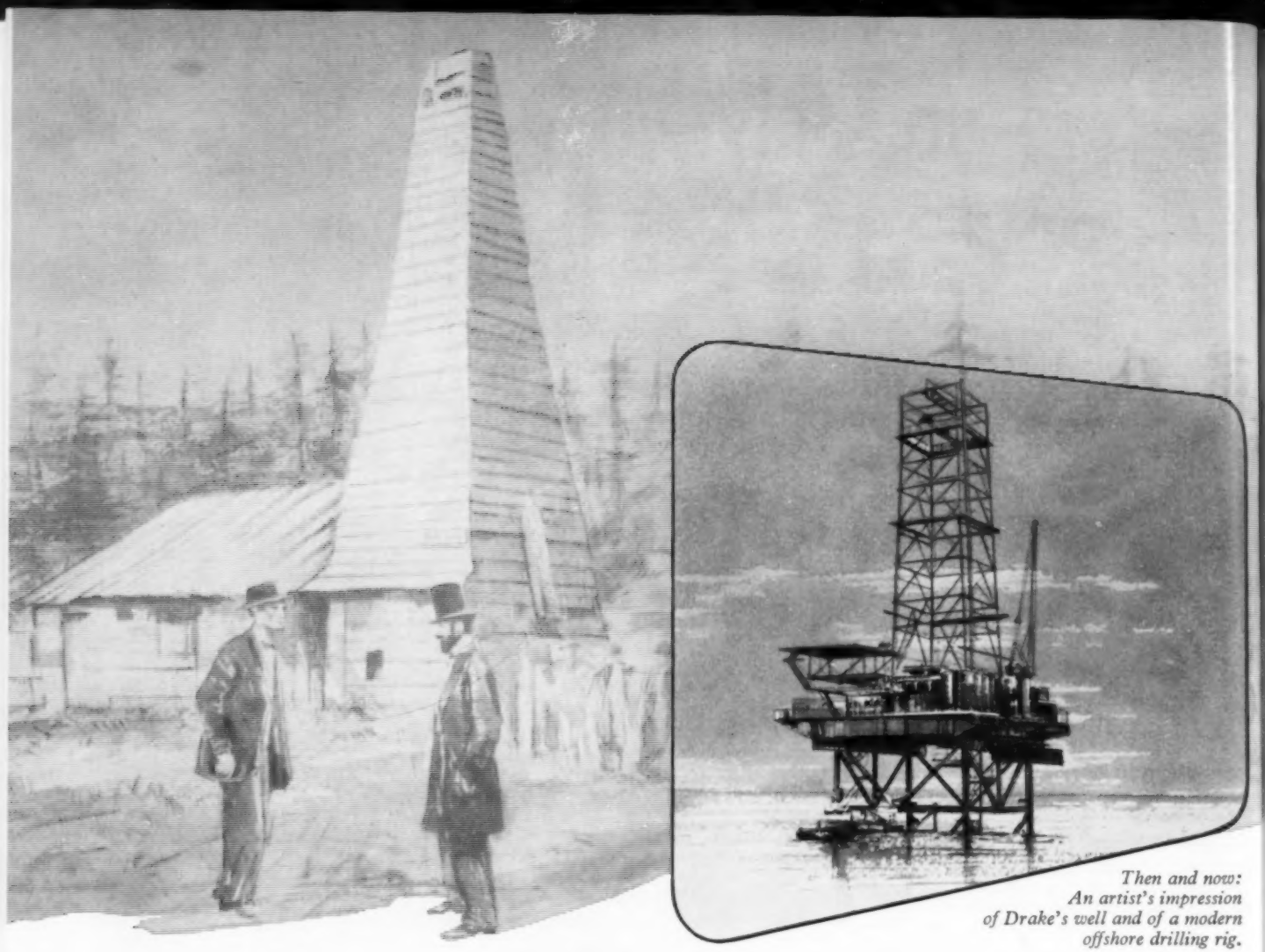

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PROPOSED CONSTRUCTION
continued

to Buenos Aires, $380 million, bids submitted for design and construction by Texas Eastern Transmission Corp., ENI, and an Argentine firm.

Gas Trunk Line of British Columbia, Vancouver, 250 miles, 30-inch, gas, main, Fort Nelson to Taylor, B. C., planned.

Gases Naturales de Colombia, S.A., 140-mile, 10-inch, gas, Cicuco field to Barranquilla, Colombia, planned.

Hughenden Pipeline, 125 miles, products, Dick Lake gasoline plant to Hughenden Region, Alta., planned.

Hydrocarbons Pipeline, Ltd., Winnipeg, Manitoba, 880 miles, 6-8 inch, products, from Edmonton to Winnipeg, $35 million, partial authorization.

Independent Pipe Line Co., 2,019 miles, 34-36-inch, crude, Edmonton to Montreal, 23,000 pump horsepower, $395 million, before Borden Commission.

Interprovincial Pipe Line Company, 350-mile extension from Toronto to Montreal, looping line from Edmonton to Toronto, crude, $240 million, considered, products pipe line, Superior, Wis., to Chicago, considered.

Mid-Continent Pipe Lines, Ltd., 1500-mile, 30-inch crude, Edmonton to Chicago, planned.

Naphtha Israel Oil Co., 75 miles, 6-inch, gas, Rosh-Zohar field to Ashdod Yam on Mediterranean planned.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

Northern Alberta Pipe Lines, Ltd., Edmonton, Alta., 110 miles, 10-inch, gas, main, Lac La Biche to Edmonton, $3 million, planned.

Northern Pipe Line Company, 153 miles, 16-inch, crude, from Regina, Saskatchewan, to Clearbrook, Minn., $10 million, planned.

Oasis Oil Co., of Libya, (Amerada, Continental and Ohio Oil Company), 86 miles, 30-inch, Dahra field to Es Sider, Libya; 36 miles, 20-inch, Mabruk to point between Es Sider-Dahra, before Libyan Petroleum Commission.

Peace River Oil Pipe Line Co., Ltd., 70-mile, crude, Swan Hills to Iosegun Junction, approved.

Petroleos Mexicanos, 4, 6 and 8-inch, products, Mexico City-Puebla to Cuernavaca, planned.

1,240 miles, 34-inch, gas, Reynosa to Mexicali, Mexico, $160 million, negotiating with Tennessee Gas Pipeline Company for design and construction of the line.

360 mile, 12-inch, products, Minatitlan to Puebla and Mexico City, planned.

Products, Guadalajara to Tepic, planned.

Products, Aguascalientes to Zacatecas, planned.

6-inch, products, Guaymas to Ciudad Obregon, considered.

8-inch products, Guaymas to Hermosillo, considered.

8-inch, gas, Tierra Blanca to Veracruz.

Gas, Ciudad Carmen to Ciudad Pemex.

8-inch, crude Comalcalco to Minatitlan.

Crude, Minatitlan to Salina Cruz, contingent on proposed refinery on Pacific Coast.

149 miles, 10-inch, products, Ciudad Pemex to Minatitlan, planned.

181 miles, 4-inch, products, Mexico City to Salamanca, planned.

Pipelines of Puerto Rico, Inc., 95 miles, 8-inch, products, Penuelas to San Juan, Puerto Rico, approved.

Provincial Pipe Lines, Ltd., 700 miles, 3-16-inch, hydrocarbon line gathering system in Alberta, $25 million, before Alberta Oil and Gas Conservation Board.

Qatar Petroleum Company, Qatar, 60 miles, 6-10-inch, gas, Dukhan to Doha, Qatar, engineering contract let to Pencol Pipeline & Engineering Consultants.

Quebec Gas Transmission Lines, Inc., Montreal, 300 miles, gas, main, Quebec to Montreal, planned.

Rangeland Pipe Line Company Limited, 111 miles, 8-inch, crude, southeastern Alberta to Calgary, $3 million, planned.

Saskatchewan Power Corp., 179 miles, 4-6-8-inch, gas, planned.

Societa Nazionale Metanodotti, 650 miles, 18-inch, crude, Genoa, to Milan-Cremona-Torino, Italy, and Aigle, Switzerland, with extensions to Karlsruhe and Munich, Germany, planned.

Societe du Pipe Line Sud-European, Paris, 432 miles, 34-inch, crude, port of Lavera to Strasbourg, with lateral extending 40 miles to Karlsruhe, Germany, approved by French cabinet.

Soc. Siciliana Metanadotti, gas line from Hassi R'Mel field in Algeria through Tunisia, across Mediterranean to Sicily and into Italy, considered.

Standard-Vacuum Oil Company, 60 miles, 8-inch, gas, main, in South Sumatra, considered.

Ste. d-Etudes de Pipeline Intercontinetaux, Paris, 1,400 miles, 30-40-inch, gas, from Hassi R'Mel field in central Algeria across Mediterranean, through Spain, France and into West Germany, considered, Fish International Corporation making engineering and feasibility studies.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

130 miles, 16-inch, gas, main line Multan to Lyallpur, planned.

Syrian Pipeline, Damascus, 500 miles, crude, from Karshuk field, Syria, to Mediterranean, planned.

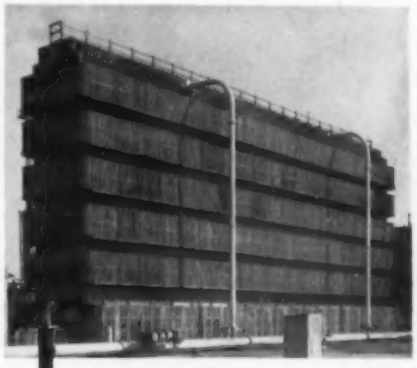
300 miles, products, from Homs to tank farms in Damascus, Aleppo and Latakia, planned.

Trans-Prairie Pipelines, Ltd., Edmonton, crude line, from Weyburn field to Regina-Moose Jaw areas, $5 million, considered.

Trunk Pipelines Ltd., London, 70 miles, products, Canvey Island to Denham,

Continued on Page 80

NEW LIFE FOR OLD COOLING TOWERS



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PROPOSED CONSTRUCTION

continued

Buckinghamshire, bill before Parliament. Extension of line from Denham to Birmingham, planned.

Westalta Products Pipeline Ltd., 900 miles, LPG, from Northern Alberta to Saskatchewan border, to deliver hydrocarbons to Foothills Pipe Lines, $40 million, before Alberta Board of Public Utilities Commissioners.

Williams-McWilliams Industries, Inc., New York, 441 miles, 6-inch, crude, Villa Montes, Bolivia, to Villa Hayes, Paraguay, considered.

Westcoast Transmission Company, 500 miles, 12-inch, crude, Taylor to Kamloops, B. C., $30 million, British Columbia government approval.

TGT Skyscraper

Tennessee Gas Transmission Company's new office building will be completed in 1963. Construction will begin this year on the 33-story skyscraper which will be erected in Houston covering an entire block bounded by Milam and Louisiana Streets and Lamar and McKinney Avenues. The 475-foot high structure will be TGT's headquarters. The building will be faced with glass and aluminum; it will have a full square block basement and a partial sub-basement, and a ground floor devoted completely to pedestrian circulation and to a glass-encased lobby while the plaza area will be finished in natural stone and landscape.

All Time High

The American Gas Association reports that the natural gas reserves of the United States have reached an all time high of 263.7 trillion cubic feet while at the same time enjoying another record breaking year of production in 1960.

New reserve discoveries were the third highest on record; discoveries of new fields and additional pools found in old fields totaled 6.6 trillion cubic feet, exceeded previously only in 1953 and 1957.

Natural gas production amounted to 13 trillion cubic feet compared with record breaking year of 12.4 trillion in 1959. Texas and Louisiana, which account for more than two-thirds of nation's reserves, had a total of 182.7 trillion cubic feet. In 1959, they had 180.4 trillion.

In Alaska, gas reserves rose sharply from 57.9 to 107.6 trillion cubic feet.

Technical Writers

The ninth annual Technical Writers' Institute is scheduled for June 12-16, at the Rensselaer Polytechnic Institute in Troy, N. Y. It is a program designed to help technical writers improve effectiveness in preparing company reports, manuals and instruction books, technical publicity and advertising and article writing. For additional information and application forms, contact Jay R. Gould, director, Technical Writers' Institute, R.P.I., Troy, N. Y.

News About Films

A new guide to technical films for use by business, industry and commerical and engineering colleges has been published by Modern Talking Picture Service. It includes more than 130 films dealing with specific technical subjects which are offered on free loan. The films are being offered to adult groups in business or industry, or to study groups in business or engineering colleges. All are 16-mm sound films, from a quarter-hour to a half-hour in length. Major corporations in various industries, as well as trade associations representing industrial and commerical groups, are sponsoring distribution of the film.

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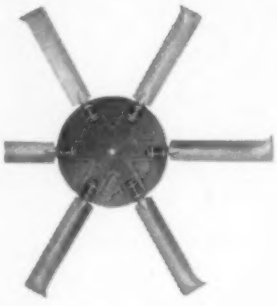
move mountains - of AIR!
in towers and exchangers



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Developed originally for the petroleum industry, Aerovent Large-Diameter "Al-metal" Propellers, constructed of tough, durable aluminum alloy, move great quantities of air at high velocities, in heat exchangers and cooling towers. Pictured above are two 4-blade, 16-ft. propellers in a cooling tower installation. These mighty propellers, with adjustable-pitch "Macheta" Airfoil blades, are job-engineered to individual specifications.

Write for free Bulletin 510

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Endurance tests, conducted at *3 times* normal loading prove the ability of these new large-diameter propellers to withstand severe punishment. Heavy-duty cast steel hubs offer maximum resistance to stresses. Angle settings for each operating requirement, and appropriate alternate settings, assure accurate pitch for any predetermined performance which may be required. 54" to 144" now available in Adjustable Pitch Models.

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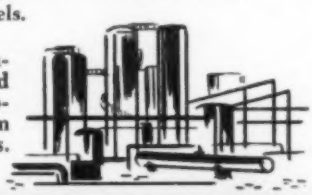

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What's Happening

among MEN in the INDUSTRY

Jim Hoss, chief engineer of **Coastal Transmission Corporation,** has been promoted to chief engineer of **Houston Texas Gas and Oil Corporation** and Coastal. Both companies are subsidiaries of **Houston Corporation.**

S. L. Windham, formerly general superintendent of pipe lines, has been named general manager of distribution properties for the Houston Corporation. **Eldon Rolfe,** chief engineer for Houston Texas Gas and Oil, will succeed Windham. **Talmadge Day,** chief accountant for Coastal, becomes internal auditor for the Houston Corporation and subsidiaries.

Donald A. Hamilton has been named assistant treasurer of **Cities Service Gas Company.** He transferred to the company from **Arkansas Fuel Oil Corporation.** Hamilton joined the Cities Service organization in 1924, and was associated with Republic Light, Heat & Power Co., Inc., and Dominion Natural Gas Co., Ltd., through 1952. In 1953, he was appointed assistant treasurer and superintendent of the Budget Department of Arkansas Companies.

James B. Henderson and **Donald Russell** have been named to the board of directors of **Transcontinental Gas Pipe Line Corporation.** Henderson has been vice president and general counsel for Transco the past 12 years. Russell is a former vice president of the University of South Carolina and now is an attorney in private practice.

J. B. Henderson

William H. Davidson, Jr., has been appointed general attorney for Transco. He was chief trial counsel for 11 years and fills a newly created post. Davidson continues as vice president and general counsel for **Trans-Southern Pipe Line Corp.**

Walter G. Horstman, vice president of **Plantation Pipe Line Company,** has retired after 38 years service with the firm. **James A. Hatfield,** general superintendent, assumes his operational activities of the company. Horstman started his career with **Shell Oil Company** in 1923, and joined Plantation in 1941. In 1946, he became general superintendent and was made vice president-operations in 1952.

Eugene H. Trust, field employe relations advisor for **Interstate Oil Pipe Line Company,** retired March 1 after over 40 years of service. He had been on a leave for several months for reasons of health. He joined the company in 1919, and served as president of Standard Pipe Line Company from 1923-36. When the company became Pipe Line Department of Standard of Louisiana in 1937, he became assistant to the vice president in charge of the Department.

Ivan C. Wyden has been named assistant research analyst of the **American Gas Association** bureau of statistics. He was a field supervisor with the Bureau of Applied Social Research at Columbia University.

William W. Shaw, assistant manager, Right of Way Department, **Sinclair Pipe Line Company,** has been appointed to succeed **Fred A. Crane,** who has retired. **Hamilton A. Cade** replaces Shaw.

Northern Natural Gas Company announces the promotion of **Maurice Coffman,** engineering and construction, to project engineer (plants) in Omaha, Neb. He joined the company as junior engineer in 1956. **Merle Stubsten,** operating, who has been with the company since 1940,

CROSE

NEW ROAD BORING MACHINE

CENTER SEAT FOR OPERATOR — Sitting in seat located directly over center of machine, operator can keep casing lined up perfectly with hole being bored.

REVERSE-O-MATIC TRANSMISSION — With this new type transmission, operator can switch auger from forward to reverse without engine slowdown. No gear shifting.

HEAVY DUTY TORQUE CONVERTER — For full, constant speed and smooth power flow, eliminating up to 90% of shock load imposed on drive train.

The new Crose Road Boring Machine provides the fastest, simplest, most economical way for boring crossings and installing casings up to and including 42" in diameter. Heavy duty torque converter and reverse-o-matic transmission deliver full, constant speed and smooth power flow . . . let you switch auger from forward to reverse without engine slowdown . . . no gear shifting.

The smaller Model RBA Crose Road Boring Machine is still available for casing up to 24".

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CASING CLAMP BANDS ELIMINATED — Instead, you use adjustable casing chains which can be easily installed or removed when machine is in ditch.

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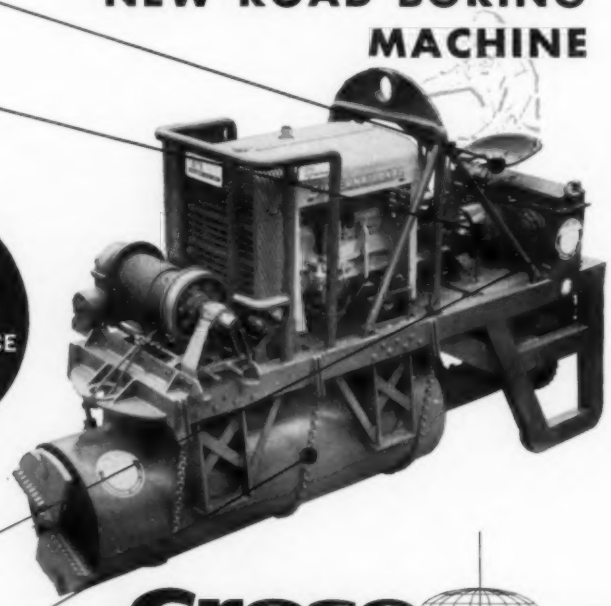

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For full information write for Bulletin T-361.

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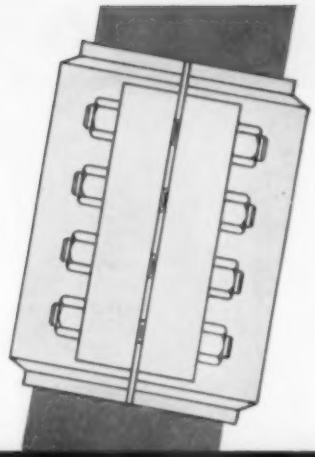

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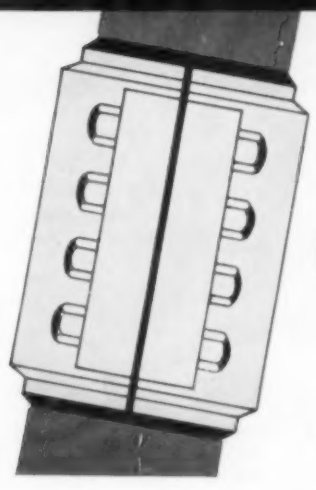
Easy installation—Place halves around pipe. Tighten side bolts. **Permits welding while pumping.** Available in standard pipe sizes. Extra lengths and special dimensions on application.



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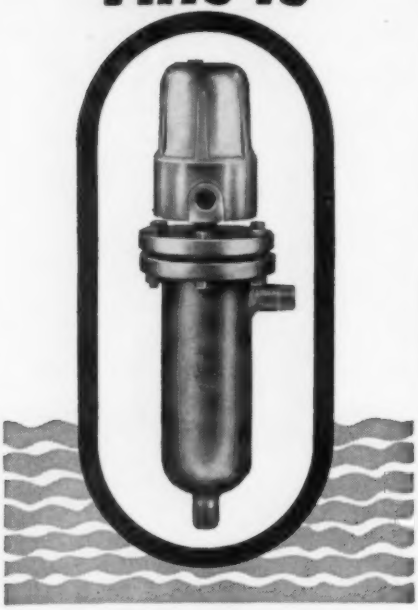

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becomes compressor plant superintendent at Waterloo, Iowa, and **Gilbert Whitlow**, engineering and construction, has been named project engineer (pipe lines) in the Omaha office.

Jerry C. Smith

Philip Bolian

Philip E. Bolian has been named traffic manager and **Jerry C. Smith** assistant traffic manager for **Service Pipe Line Company.** Formerly assistant traffic manager, Bolian succeeds **B. W. Russell** who retired after 34 years with the company. Smith had been a rate clerk and replaces Bolian.

Pacific Lighting Gas Supply Company announces the promotion of **Robert L. Weil, Arthur W. Low** and **Harold T. Johnson** in the treasurer's department. Weil advances from auditor to general auditor; Low, formerly chief accountant, becomes supervisor of accounting, and Johnson moves up from administrative aid to assistant treasurer. Changes resulted from the retirement of C. Edward Pearman, vice president and treasurer.

Leonard M. Hammer, former manager of **American Gas Association's** promotion bureau, was named manager of the AGA Gold Star Gas Appliance Program. **Stephen J. Van Osten** succeeds Hammer. Van Osten had been assistant in the promotion bureau since 1960. Hammer joined the AGA in 1958.

Cecil E. Schultz has been appointed director of production and pipe line accounting for **Continental Oil Company.** Schultz, formerly associate director of production and pipe line accounting, succeeds **E. H. Loosley,** who retired. Schultz joined the company in 1944.

Herbert E. Fisher, president of **Pipe Line Technologists,** was named "Boss of the Year" by the Houston Chapter of the **National Secretaries Association.**

The association is the largest organization of women in one profession in the world. Its objective is to elevate secretarial performance standards through continued educational programs.

Howard E. Kirby, Jr., has been named assistant supervisor of the **Texas Eastern Transmission Corporation's** engineering plans and research division. Kirby has been with the company since 1948. He had been in the construction division in charge of the gas turbine section before being transferred to the plans and research division in 1959.

Several promotions have been made by **Columbia Gulf Transmission Company. August F. Quesada** and **Jack M. Spinks**

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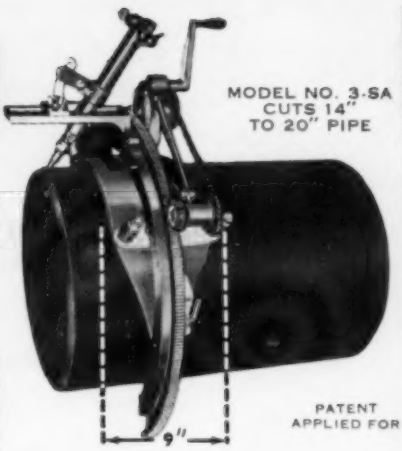

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- More rugged . . . this new design produces a more stable ring gear assembly, which is less likely to spring or warp.
- Retains extreme accuracy of cuts, which all Mathey Pipe Beveling Machines are noted for.
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have been moved up from design engineers to project engineers. **Glenn L. Tollerene** was advanced from assistant to design engineer and **Robert L. Schneider** was promoted from chief draftsman to design engineer.

James M. Simpson, formerly an engineer, was named assistant design engineer. **Albert A. Mullins** joins the company as an engineer and **David W. Pillion** becomes chief draftsman.

Donald B. Reeve has been named western regional manager for the **LP-Gas Council.** He will handle public relations and membership recruitment throughout the 11 western states with headquarters in Beverly Hills, Calif. Reeve has been account executive with Hill and Knowlton, Inc., public relations company, for the past eight years.

Frank P. Peterson has been elected chief executive officer of **Southern Pipe Line Corp,.** and **Southern Mineral Corp.,** succeeding **Maston Nixon,** who has retired but remains a director and consultant.

Peterson, who is president of the companies, has been with the firms for 24 years.

R. A. Hamill, chief gager, has been named supervisor of scheduling and measurement for **Service Pipe Line Co. K. K. King,** acting chief oil dispatcher, becomes scheduling supervisor and **R. E. Boyle,** assistant chief gager, was made measurement supervisor.

Northern Natural Gas Company has named **Charles H. Ward** director of the Engineering Design Department. Ward joins Northern after serving with Williams Brothers Company as project engineer on pipe line design and construction in Middle East, South America and in the United States. He will be responsible for the design of Northern's plant and pipe line facilities. Ward began his career with Phillips Petroleum Company and joined Williams Brothers Company in 1956.

Charles H. Ward

Sinclair Pipe Line Company has elected **Charles T. Carter** vice president. He is a director and director of engineering. Carter joined the company in 1938.

In a diversification move, **Houston Corporation** has organized a production company subsidiary, **Coastal Production Company** with offices in Houston. Officers include **W. J. Bowen,** Houston Corporation president; **H. L. Wilwhite,** executive vice president, and **Leon Payne,** secretary-treasurer.

S. A. Hallberg, formerly manager of Chicago Division of **American Oil Company's** product pipe line, has been named to supervise scheduling and dispatching all bulk liquid product movement for the company.

He has been with **Standard Oil Company** organization since 1946.

BOOKS

Standard for Field Welding of Pipe Lines, American Petroleum Institute, 1271 Avenue of the Americas, New York, 20. $.50.

This is the seventh edition of API standard 1104, prepared by the division of transportation of the API. The 1104 code is well established in the industry as a guide for pipe line welding procedures in the field.

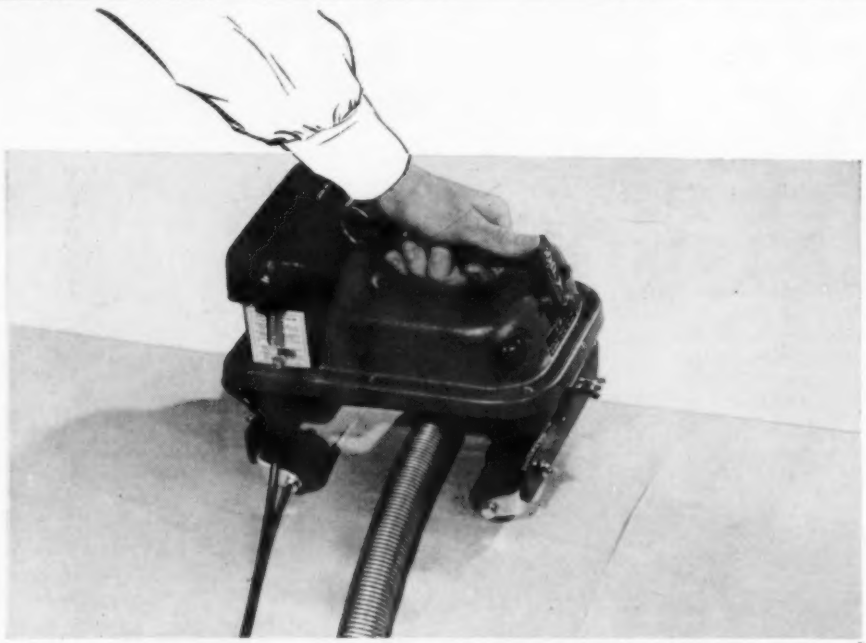
Two major changes in this year's edition were adopted so that one size die and plunger could be used for all guided bend tests, regardless of type or thickness of material tested.

Historical Statistics of the United States, Colonial Times to 1957, U.S. Bureau of Census, Department of Commerce, Washington 25, D.C. $6.

A statistical account of the history of United States contains information on everything from population per household in 1790 to average hourly pay in 1957.

The book compiles over 774 pages of tables and explanatory matter in charting the growth and development of the United States through 1957.

Some of the gems that this study has produced include the fact that from 1820 to 1950, males outnumbered females—but in 1950 the women took the lead 75.8 to 74.8 million. In 1906, all but 0.8 percent of the civilian labor force was working—the only time from 1900 to 1957 that the figure was under one percent.



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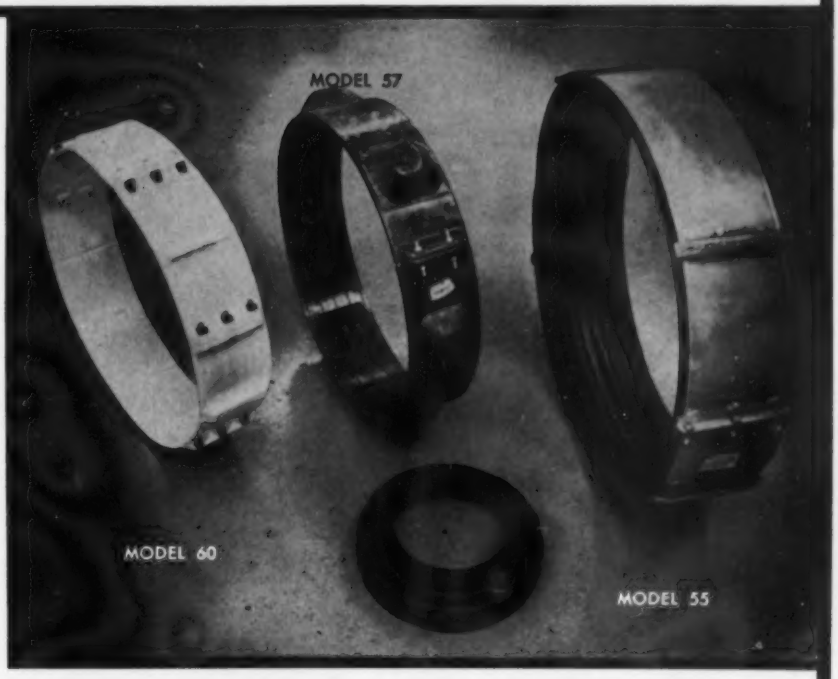
BUILT FOR RUGGED DEPENDABILITY

CROSSING INSULATORS

Precision made of Neoprene and metal or molded fiber glass reinforced polyester resin or high-density polyethylene. Easily installed. Competitively priced.

CASING SEALS

There are slip-on and zipper types of tough Maloney-compounded synthetics to fit almost all specifications or adverse installation conditions.



F. H. Maloney COMPANY ®

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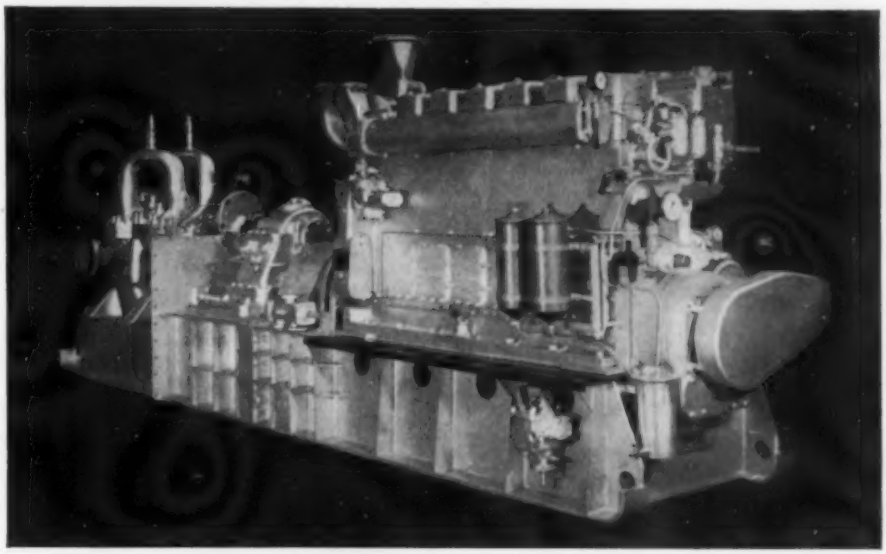

Explosion-protected Pipe Line Pumping Set consisting of MWM four-stroke Diesel type TRHS 526 S rated for 310 HP at 850 rpm and four-stage KSB Pump type GPL – 1000 with a delivery of 120 m^3/hr (70.5 cu. ft/min) at 526 lbs/in^2 gauge pressure.

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the engine deserving of your confidence

The MWM Diesel Engine production programme is conceived to provide for the largest possible field of application, comprising four-stroke engines from 8 to 2000 HP. For the Petroleum Industry we supply rugged powerful engines to drive field equipment, complete high pressure pipe line pumping sets and Diesel-generator units.

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Under any climatic extreme the all mechanical GRAVITOMETER measures specific gravity for use in orifice meter measurement. No *controlled* or *conditioned* atmosphere is required, and there are no complicated or critical adjustments to make for atmospheric variations.

The GRAVITOMETER was designed to eliminate errors in the float-type gravitometer when variations occur in the temperature and density of the atmosphere surrounding the sample float.

The GRAVITOMETER can be installed without the use of highly trained technicians, and is easily operated and maintained. Completely automatic, it produces positive, accurate and correct specific gravity measurements.

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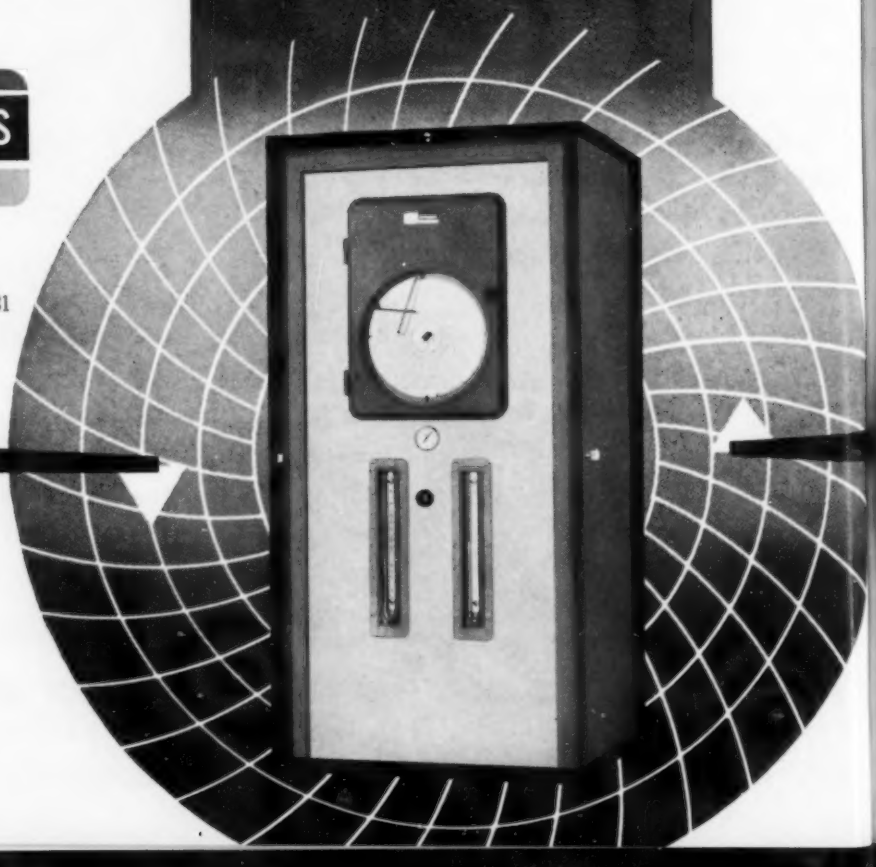

WHO'S MEETING WHERE

April

ASME, oil and gas power conference and exhibit, Jung Hotel, New Orleans, April 9-13.

ASME, maintenance and plant engineering conference, Bancroft Hotel, Worcester, Mass., April 10-11.

PIEA-PESA, annual meeting, Moody Center, Galveston, Texas, April 11-13.

University of Oklahoma, Southwest Gas Measurement Short Course, North Campus, Norman, Okla., April 18-20.

American Welding Society, meeting and show, Commodore Hotel, New York, April 18-20.

AIME Society of Petroleum Engineers, East-Texas, Louisiana, Arkansas gas technology symposium, Tyler, Texas, April 20-21.

Illinois Society of Professional Engineers, annual convention, Peoria, Ill., April 20-22.

Southern Gas Association, annual convention, New Orleans, April 24-26.

API, Division of Transportation, annual meeting, Chase Park Plaza Hotel, St. Louis, Mo., April 26-28.

NGAA, Oklahoma regional meeting, Lake Murray Lodge, Ardmore, Okla., April 28.

May

Pacific Coast Gas Association, transmission conference, Biltmore Hotel, Santa Barbara, Calif., May 4-5.

AGA, operating section, distribution and production conference, Sheraton Hotel, Philadelphia, May 8-12.

NGAA, Permian Basin regional meeting, Lincoln Hotel, Odessa, Texas, May 19.

ISA, AIEE, ARS, IAS, IRE, National Telemetering Conference, Chicago, May 22-23.

AGA, Operating Section, transmission, annual meeting, Brown Palace, Denver, May 25-26.

June

ASME, summer annual meeting, Statler Hilton Hotel, Los Angeles, June 11-14.

Canadian Gas Association, annual meeting, Grand Hotel, Mackinac Island, Mich., June 20-24.

September

AIEE, petroleum industry conference, New New Orleans, September 17-20.

ASME, petroleum division conference, Kansas City, September 24-27.

October

ASME-ASLE, lubrication conference, Morrison Hotel, Chicago, October 17-19.

NOW—Complete Anchoring Service

- ENGINEERING
- TESTING
- INSTALLATION

Use the Chance Field Service Plan . . . the surest, easiest, most reliable, and least expensive way to anchor pipelines. You'll cut costs about 85% by using Chance Screw Anchors and tie-down brackets. And, you can have the whole project engineered, installed, and tested by qualified technicians at far less cost than counter weighting.

Chance application engineers will conduct soil test probes (photos A & B) to determine where anchors should be installed, the size anchors needed, and the proper anchoring depth. Pull tests (photo C) will verify their recommendations. Then, for a reasonable fee, Chance will provide special installation equipment, and the services of an installation supervisor.

Here's one job you can leave to *Chance!* You'll save money, too, because Chance Anchors cost much less than counter weights. And, they're lighter and less bulky than counter weights . . . cheaper to transport, easier to store. A complete unit (two anchors and one bracket) weighs from 29 to 180 pounds, and will hold 5,000 to 30,000 pounds.

Call or write for complete information on the Chance Field Service Plan.

A

B

C

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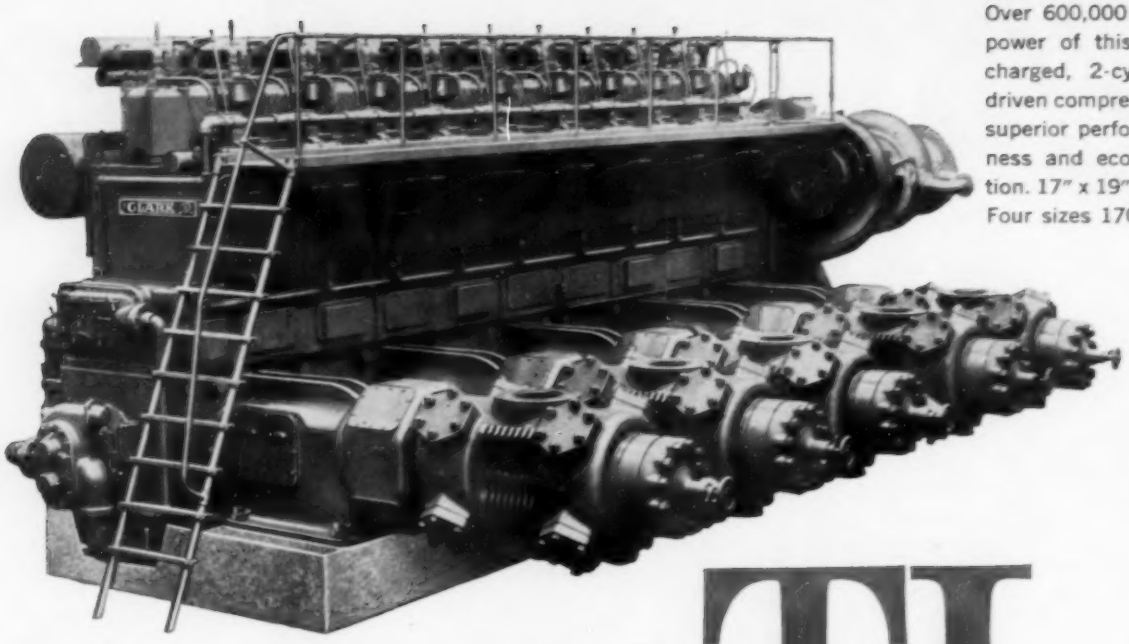
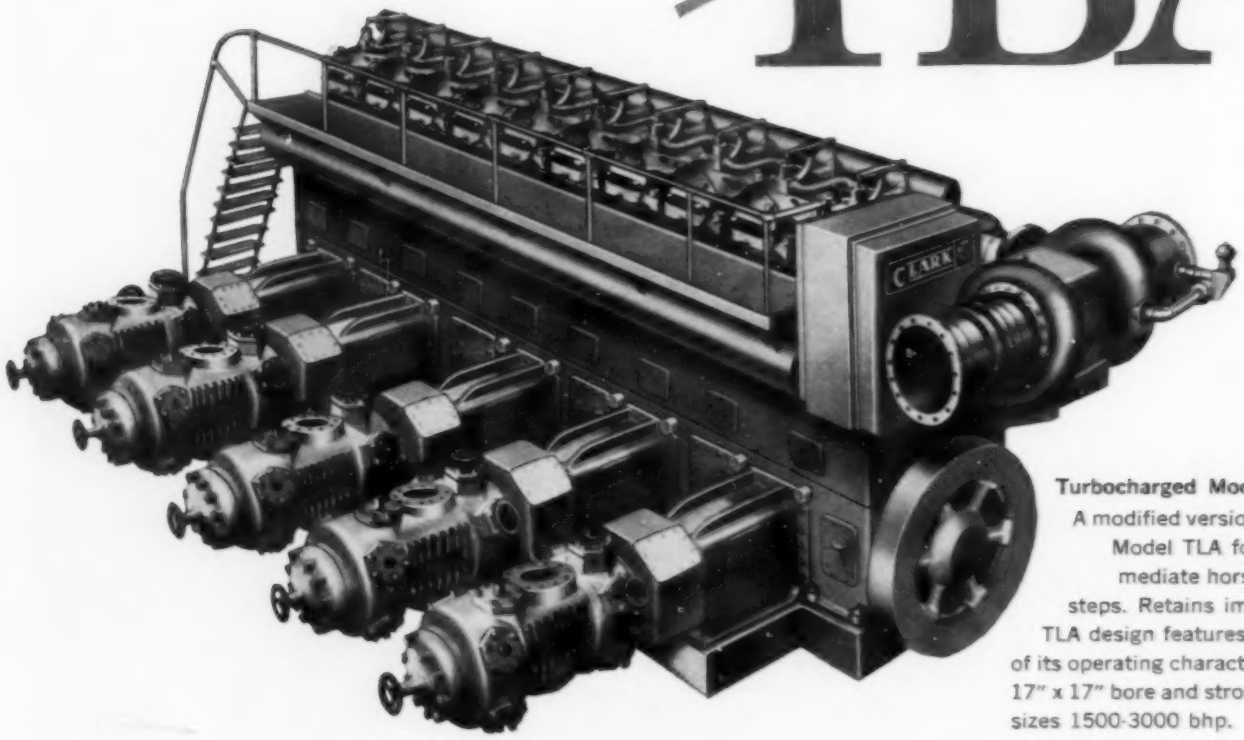
INTERNATIONAL DIVISION • CENTRALIA, MO., U. S. A.



Popular Model TLA
Over 600,000 installed horsepower of this famous turbocharged, 2-cycle gas-engine driven compressor testify to its superior performance, ruggedness and economy of operation. 17" x 19" bore and stroke. Four sizes 1700-3400 bhp.

the CLARK TLA TBA



Turbocharged Model TBA
A modified version of the Model TLA for intermediate horsepower steps. Retains important TLA design features and all of its operating characteristics. 17" x 17" bore and stroke. Four sizes 1500-3000 bhp.

Now you can name the horsepower—from 1500 to 3400 bhp—and name Clark with confidence. Clark has the compressor to fit your needs *exactly!*

With the addition of the TBA Series (a modified version of the time-tested Model TLA 2-Cycle, Gas-Engine-Driven Compressor), Clark now offers eight closely graduated sizes in this important horsepower range for pipeline and process applications.

The TBA is carefully matched to the TLA, giving you not only the best horsepower choice, but also a machine you can trust. Here's how it's done:

Same Heavy Duty Construction—The TBA incorporates the lower crankcase with thru-bolts, crankshaft, power pistons, compressor cylinders, aluminum bearings and running gear of the TLA—all thoroughly proved in exacting field duty. Both machines are specifically designed to handle the high power delivered by turbocharging.

Same High Efficiency Turbocharging System—The Clark designed, constant pressure turbocharger provides a flexible supply of combustion air that varies in proportion to the load placed on the engine. Thus the fuel-air ratio is inherently correct over the entire operating range.

Same Operating Flexibility—The turbocharger system coupled with a new automatic ignition timing control makes the TBA and the TLA ideally suited for variable speed, variable load applications. The fuel consumption curve remains essentially flat over a wide range . . . from reduced speeds at constant or variable torque all the way up to substantial emergency overloads at rated speed.

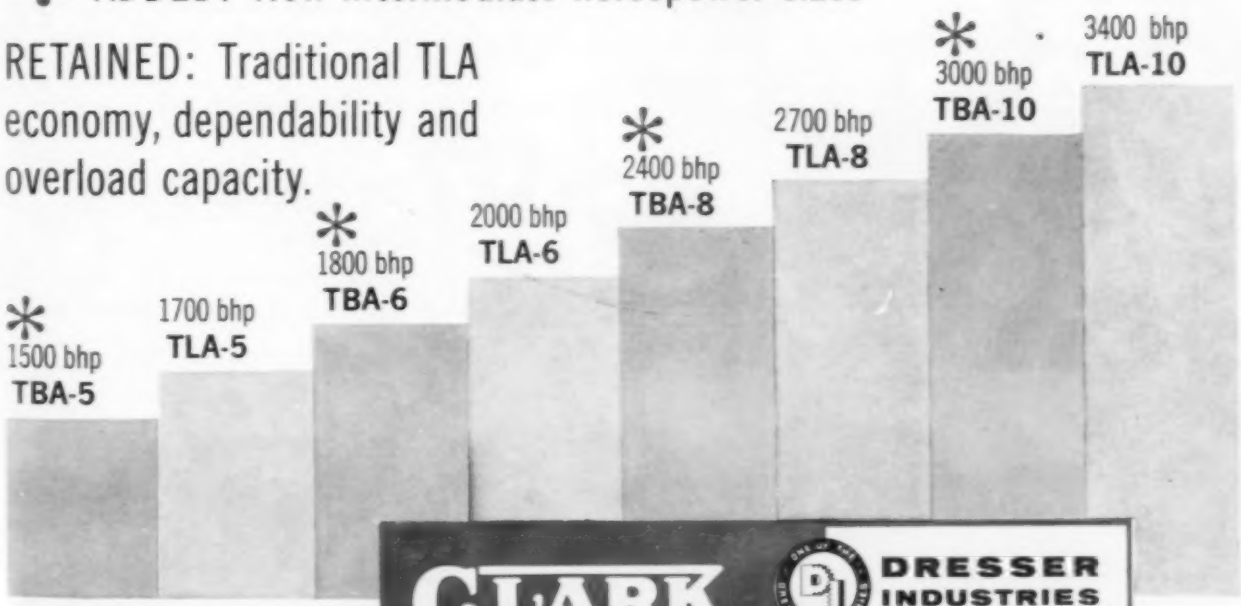
What's different, then? The stroke on the TBA has been shortened from 19" to 17", the external configuration of the power cylinders has been modified, and the ratings have been changed in accordance with the new stroke length. The TBA is built in five, six, eight and ten power cylinder models rated at 1500, 1800, 2400 and 3000 bhp respectively.

More facts are yours for the asking. Write for new Clark TBA Bulletin 206, and new TLA Bulletin 225.

Line is IN STEP with your pipeline or process requirements

✻ ADDED: New intermediate horsepower sizes

RETAINED: Traditional TLA economy, dependability and overload capacity.



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OLEAN, N. Y.

CLARK
GAS TURBINES

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OIL • GAS • CHEMICAL
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For more data on advertised products, use Readers' Service Cards, last page.

What's Happening among SERVICE and SUPPLY MEN

Koppers Company Elects Three Vice Presidents

Henry A. Denny has been named vice president and general manager of engineering and construction division; Chester E. Brown was elected vice president and general manager of tar products division, and John H. Redmond becomes vice president and marketing manager in the tar products division of Koppers Company, Inc.

Former assistant general manager of his division, Denny succeeds Dr. Walter C. Rueckel, Brown succeeds Fletcher L. Byrom, who recently was elected president, and Redmond replaces Brown.

Rockwell Makes Stacy Valve Actuator Manager

Thomas I. Stacy has been named manager of Rockwell Manufacturing Company's newly established Valve Actuator Products Department. He had been pipe line and gas utilities valve sales assistant manager. Stacy joined the company in 1938, became Houston sales manager in 1954, and was appointed to his recent post in 1957. His headquarters are now in Pittsburgh.

E. C. Chapman Appointed Caterpillar Assistant Manager

E. C. Chapman has been appointed assistant manager of Caterpillar Tractor Company's Sales Development Department. Also, the southwest and northwest sales divisions of Caterpillar have been merged into the new western division, managed by J. A. Justeson. W. E. McCoy, manager of the southwest division, succeeds Chapman as manager of eastern division.

E. C. Chapman

Chapman joined the company in 1945, and became assistant manager of eastern sales in 1952. In 1956 he was named manager.

Bucyrus-Erie Co. Appoints Thierry to Board of Directors

John Adams Thierry has been elected a member of the board of directors of Bucyrus-Erie Co., and Merlin H. Birk has been named a vice president.

A vice president, Thierry has served as secretary since 1958, and general attorney since 1957. He joined the company in 1940. Birk has been the company controller since joining the firm in 1959.

Hill Hubbell Appoints District Sales Manager

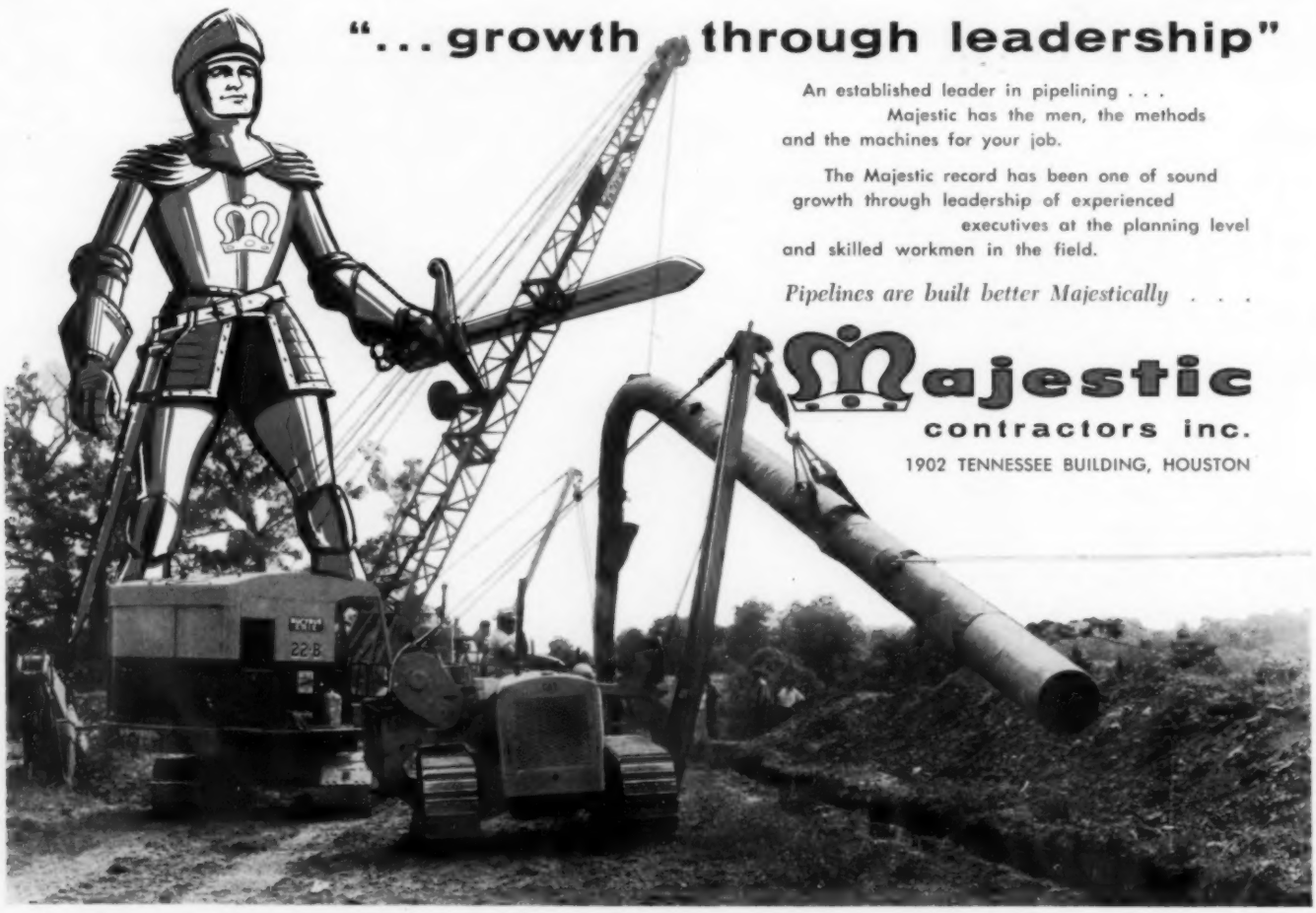
Robert G. Meihls has been appointed district sales manager of the middle Atlantic for Hill Hubbell Co. He will represent the company in New York City, eastern Pennsylvania, New Jersey, Delaware, Maryland, Virginia and Washington, D.C. He will be based in New Jersey.

Gale Carroll Promoted Executive Vice President

Gale Carroll has been named executive vice president of Tube Process Corp. Formerly sales manager for Tube-Kote, Carroll has been in the internal coating field since 1945.

Worthington Corporation Announces Five Appointments

Lewis M. Evans has been named eastern region resale sales manager, marketing division, for Worthington Corporation. Other appointments include Theodore Davenport named to the new position of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An established leader in pipelining . . .
Majestic has the men, the methods
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and skilled workmen in the field.
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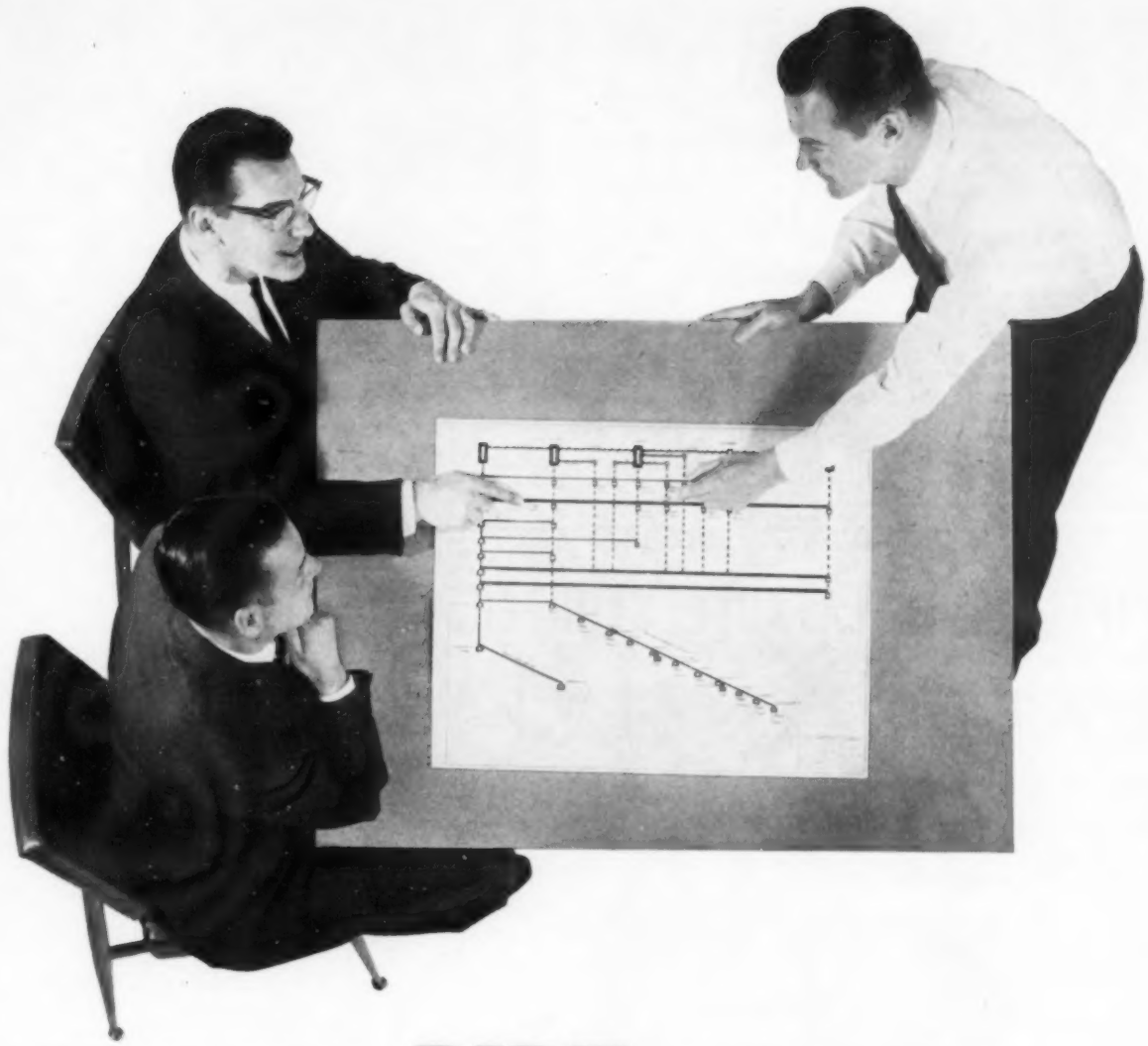

PRACTICAL PIPE DREAMING

Stromberg-Carlson's unique new-approach to Pipeline Communications

Your new communication system—or the efficient modernization of your present one—can begin in a meeting like the above.

The locale is the Stromberg-Carlson Telecommunication division—specialists in telephone communication since 1894.

The men are specialized engineers who have devised a fresh, practical, waste-eliminating system *specifically for pipelines.*

Modular in application and amazingly versatile, it can be adapted to meet any requirement—including some truly "unusual" specifications we've handled recently!

A letter, wire or phone call to Stromberg-Carlson's PIPEdreaming department, 127 Carlson Road, Rochester 3, New York, will reserve you a chair in an early session.

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GENERAL DYNAMICS | ELECTRONICS
General Dynamics | Electronics is a division of General Dynamics Corporation

We're proud to have our equipment serving many of the outstanding oil and pipeline companies in America. Ask us to tell you who they are.

manager of planning and Robert R. Rhodes manager of sales for Worthington's Standard Pump Division. Joseph E. Seibold becomes manager, administration, Resale Sales Department of marketing division and Elliot M. Richman has been appointed supervisor of original equipment manufacturer sales, resale sales.

Dixon Chosen Manager McGuffy Midwestern Office

Robert R. Dixon has been named manager of the newly created Midwestern office in Chicago for Lynn McGuffy Co., Inc. Prior to joining McGuffy, Dixon had served with Houston Texas Gas and Oil Corporation as chief inspector, station superintendent and assistant chief engineer in charge of compressor station and meter station design.

Melvin M. Jones Joins Crutcher-Rolfs-Cummings

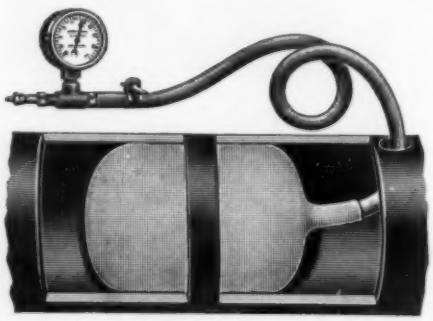
Melvin M. (Hap) Jones has joined Crutcher - Rolfs-Cummings as a Houston sales representative. Jones had been with Crose-Perrault for the past four years as a Houston representative.

At C-R-C, he will handle city sales. Jones is a member of the National Association of Corrosion Engineers.

Melvin M. Jones

PIPELINE INFLATABLE STOPPERS

BALLOON-TYPE



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COVERS OF CANVAS, DUCK, DYNEL,

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Catalogue on Request

Ludlow-Valve Company Names Wilkinson Regional Manager

Robert L. Wilkinson has been appointed central regional manager for the newly reorganized Ludlow-Valve Company. His territory will cover area from Chicago to Kansas City. Wilkinson had been with Tube Forgings Company.

Collins Radio Company Elects R. P. Dutton Vice President

Robert P. Dutton has been elected vice president government representative for Collins Radio Company. Dutton, formerly manager of Collins Washington, D.C., office, has been with the company since 1952. In 1953, he established and became director of the Washington office.

Walworth Names Malloy Division Sales Manager

Michael C. Malloy has been named western divisional sales manager, Lubricated Plug Valve Division, Walworth Company, with headquarters in Houston. Malloy has been with Walworth and its subsidiary, Grove Valve & Regulator, for three years as a sales engineer.

Malloy previously worked with Marshall J. Brown Company. He is a member of the American Gas Association.

Michael C. Malloy

ACF Industries Elects J. S. Downs Vice President

J. S. Downs, general manager of W-K-M division of ACF Industries, Incorporated, has been elected a vice president. Other appointments announced include naming B. J. Gross, director of marketing; H. C. Tooley, director of manufacturing, and R. O. Wynn, director of quality control and customer service for W-K-M.

MacDonald Elected President of Electro Rust-Proofing Corporation

Frank P. MacDonald has been elected president of Electro Rust-Proofing Corporation. He has been with the company since 1939, when he joined as a sales representative. E.R.P. Corp. became a subsidiary of Wallace & Tiernan Inc., in 1946, and in 1947, MacDonald was appointed sales manager.

CompuDyne Corp. Enters Telemetering Field

CompuDyne Corporation is expanding into the telemetering field. A full-scale development program will cover all phases of telemetering. Murray Kraus has been named product manager. He had been with Ascop Division of Electro-Mechanical Research Corp.

Valley Manufacturing Promotes Robert Finnman to Vice President

Robert E. Finnman has been named vice president, sales, steel pipe division and a member of the board of directors of Valley Manufacturing Company.

Formerly sales director of Valley's steel

INDUSTRY-WIDE USE

BUILT ON OUTSTANDING PERFORMANCE

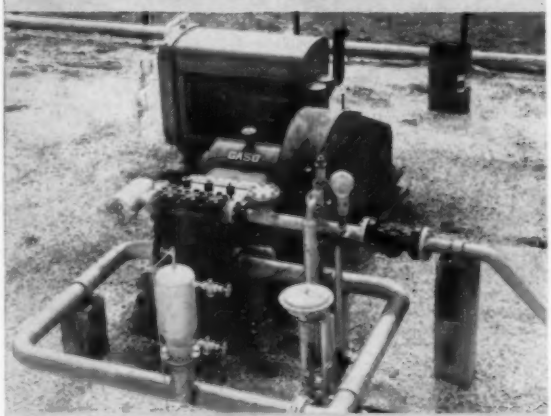
Not too long ago Gaso Pumps were known principally for their work in pipe line service.

Today they are specified in ever increasing volume by all branches of the industry.

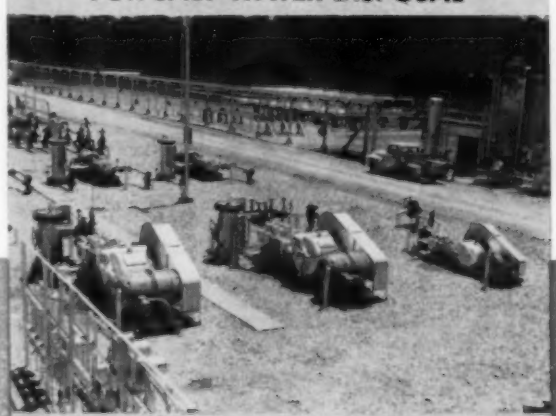
The reason is obvious: Engineers concerned with water flooding, salt water disposal, oil well cementing, oil well acidizing and fracturing, LPG underground storage, mine water disposal and other operations involving pumps are just as interested as pipe line engineers in the extra years of trouble-free service which have become a Gaso trademark.

Performance speaks a universal language, and it's performance upon which Gaso leadership is built.

GASO PUMPS IN PIPELINE SERVICE



GASO PUMPS
FOR SALT WATER DISPOSAL



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for every oil industry need

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Wichita Falls, Texas – Pump Engineering Co.
Evansville, Ind. – Hague Equipment Co., Inc.
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1950
PITT CHEM MODIFIED®

1954
PITT CHEM HOTLINE®

1955
PITT CHEM TARSET®

1959
PITT CHEM QUICK-DRY®

Now in development
PITT CHEM PIPELINE TARSET®

PITT CHEM

FIRST in Development of Better Pipeline Coatings!

Providing solutions to pipeline protection problems, through the development of better pipeline coatings, is one of the reasons why Pittsburgh Chemical has long been recognized a leading supplier to the pipeline industry. During the past decade Pittsburgh has developed four outstanding coal tar base coatings for the pipeline industry. These include:

Pitt Chem Modified Enamel — the original "medium range" coating, which can be applied during most seasons of the year and is able to withstand above-normal service temperatures.

Pitt Chem Hotline Enamel — a superior coating which offers exceptional resistance to penetration, puncture, soil stress and distortion and gives outstanding protection to pipelines operating in the 180°F range.

Pitt Chem Tarset — a revolutionary, cold-applied coal tar-epoxy resin coating used extensively for protecting pipeline joints, fittings, and patch work.

Pitt Chem Quick-Dry Primer — a universal primer that drys to touch in 3 to 5 minutes and permits immediate follow-up with coating and wrapping.

Pitt Chem Pipeline Tarset — extensive field and laboratory test programs are now being conducted in conjunction with the application of a new formula, cold applied, pipeline Tarset. Periodic reports on this program will be brought to your attention.

For a complete selection of performance-proven pipeline coatings . . . and for the newest and best in *improved* products for pipeline protection, you can depend upon Pittsburgh Chemical!

2035

PROTECTIVE COATINGS DIVISION

PITTSBURGH CHEMICAL CO.

GRANT BUILDING PITTSBURGH 19, PA.

A Subsidiary of PITTSBURGH COKE & CHEMICAL CO.

pipe division, Finnman has been with the company for four years.

Transportation Sales Manager Announced by Fiberglas Corp.

Harry H. Chapman has been named transportation sales manager for Owens-Corning Fiberglas Corporation's sales to manufacturers division. He will be in charge of sales to transportation industry and development of new applications of insulation, and other products. Chapman has been with the company since 1950.

Motorola Names Russum Regional Sales Manager

Paul E. Russum has been named regional sales manager of North Central Texas and Oklahoma for Motorola Communications and Electronics, Inc. He will supervise the sale of two-way radio and other communications products. Russum's headquarters will be in Dallas. His territory also will include parts of Missouri and Arkansas.

Paul E. Russum

Russum has been with Motorola since 1954, and was zone sales manager in the Dallas-Ft Worth area.

Grove Valve and Regulator Co. Names Williamson Vice President

Grove Valve and Regulator Company has appointed Kenneth F. Williamson vice president and product manager- valves. Williamson had been sales manager. He has been with Grove for two years. Previously, he was associated with W-K-M as sales coordinator.

Turner & Company Named Fulton Sylphon Distributor

Robertshaw-Fulton's Fulton Sylphon Division has appointed Turner & Company of Metairie, La., as sales representative for southern Louisiana. Henry D. Turner will be in charge of the new sales office.

CLASSIFIED ADVERTISING

Manuscripts Wanted

Have you written a book you would like to have published? Do you have an idea or an outline that you would like to talk over with a publisher? Gulf Publishing Company, publishers of World Oil, Petroleum Refiner and Pipe Line Industry magazines, and numerous technical books, is actively seeking trade and technical manuscripts for publication by its rapidly expanding Book Division. For further information write to Manager, Book Publishing, Gulf Publishing Company, P. O. Box 2608, Houston 1, Texas.

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Divisions: INDUSTRIAL • Electrical and Mechanical Dust Collectors • Wet Collectors • Fans • Fan-Stacks • Blowers • Gas Scrubbers • Air Preheaters • Curtain Dampers.
AIRCRAFT EQUIPMENT • Advanced electro-mechanical equipment for the aircraft, missile and nuclear industries.
AEROTHERM • Aircraft lounges, passenger and crew seating.

For more data on advertised products, use Readers' Service Cards, last page.

Paywelder® rigs "wade" track-deep to make 150 joints per day!

Through "hip-boot" mud and water conditions, International® Pay welder rigs, on 24-inch tracks, claw their sure way. Even in this adverse going, the stringer-bead and hot-pass crews make 150 joints per 10-hour day—getting 6,000 feet of line daily.

This is a Panama Williams Corporation looping job in Louisiana for Trunk Line Gas Co. Panama Williams also uses another Pay welder team on a second looping job. Without the mud to fight, the second pair does up to 7,500 feet daily, making 165 welds!

The International Pay welder is a factory-engineered, factory-built, high-output 325-amp machine. It's powered and carried by the 6-cylinder TD-15 crawler tractor, equipped to produce 120 intermittent hp. This compact, go-anywhere power package carries two Lincoln dual welders (4 welders), with four welding leads—is V-belt-driven from front pto. Pay welder comes standard equipped, fore and aft, with rugged steel extension platforms. Mount your clamp-actuating compressor on the front platform, and drive it from front pto extension that's provided. And carry extra pipe clamps and supplies on the rear platform. No separate compressor engine—no "supply wagon"—needed!

Self-contained and self-propelled, the spread-speeding Pay welder has the ground-hugging stability of 74-inch gauge tracks to operate on all terrain. For maximum flotation-traction use 24-inch track shoes.

Put a Pay welder to the toughest test you can find. Then compare the cost-cutting ability, the earning capacity of this factory-built, field-proved welding unit. See what it means to generate the current, power the compressor, and transport supplies with one mobile, one-man-operated unit. Let your International Construction Equipment Distributor demonstrate.

In "soupy" mud, two International TD-15 Pay welder units keep the crews producing—keep the job going—on the Panama Williams Corporation line-looping job near Rayville, Louisiana. "I can set the welder controls and run three or four hours without ever changing them," states the operator of the lead Pay welder. All controls of the Lincoln dual welders are easy to reach and regulate—all indicator dials are easy to read!

Through a "frog-pond," the Pay welder navigates—"pouring" out the 325-amp current to keep four welders busy. Precision-type metal-to-metal cartridge-type seals protect the Dura-Rollers on TD-15 tracks from water and abrasives. These track rollers with king-size reservoirs give 1,000-hr lubrication intervals!

p swamp

—for Panama Williams Corporation, Houston, Texas

International® Construction Equipment

International Harvester Co.,
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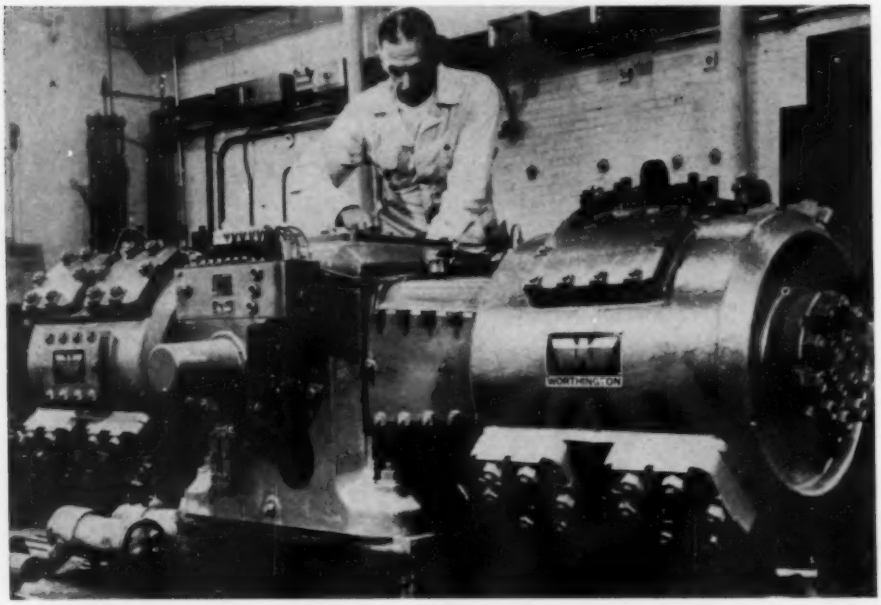
A COMPLETE POWER PACKAGE

What's New in EQUIPMENT

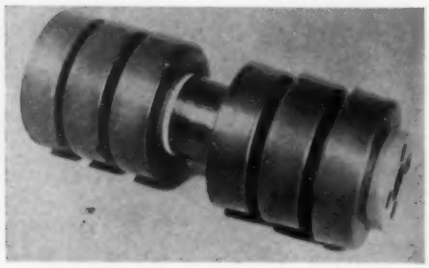


Packaged Compressors

Worthington Corporation announces a new balanced-opposed compressor designed for higher speed operation especially for use in gas gathering, gas lift and repressuring.

The units are semi-portable compressors in the range of 200 to 350 horsepower. The compressor is a 5-inch stroke, 1,000 rpm, two-cylinder, horizontal balanced-opposed type for direct coupling to high speed gas engine. Offered in units for pressure up to 2,000 psig, the compressors were designed for unattended outdoor installations.

For more data, circle **No. E1** on Readers' Service Card, last page this issue.



Plastic Pigs

Two new lightweight plastic pigs for separation and displacement of fluids and gases have been introduced by T. D. Williamson Company. The pigs, SBN-5PL and SB-6PL, will be used for separation of dissimilar fluids, displacement of gases with liquids and liquids with gases, removal of condensate from gas lines, and other "squeegee" uses.

Available in sizes 4 through 14 inches, the lightweight units provide minimum cup loading and multiple sealing surfaces keep constant seal under typical conditions. The pigs require no special handling, assembly or disassembly.

(This item supplements T. D. Williamson, Inc., data on pages 573-576 of Pipe Line Catalog, Third Revision).

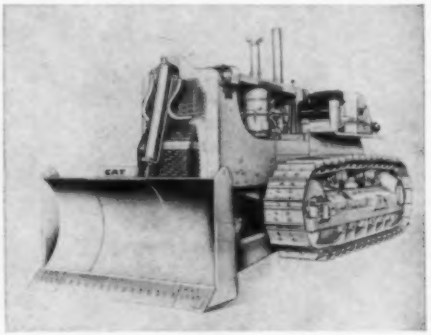
For more data, circle **No. E2** on Readers' Service Card, last page this issue.

Pressure Indicator

A 115-volt pressure indicator, the Teledyne 236, has been introduced by Taber Instrument Corp. The unit consists of a voltage-regulated 60-cycle power supply for excitation of the strain gage bridge, an amplifier power supply and a transistor amplifier to increase voltage level of bridge output to dc meter movement.

A momentary contact switch which electrically unbalances the strain gage bridge to precisely 80 percent full scale, is provided to check calibration of the entire indicator-transducer system.

For more data, circle **No. E3** on Readers' Service Card, last page this issue.



Dozers

Caterpillar Tractor Co. announces the new, cushion action push dozers No. 8C and 9C. These units incorporate a single lift cylinder for hydraulic controls. A case mounted cushion push block for the D8H and improvements to the 176 hydraulic control for the D8H and 184 hydraulic control for the D9E also have been made available.

The single lift cylinder gives operators improved vision. Improved cushioning was achieved by lengthening travel distance before "bottoming" of the four rubber springs.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.

Computer Scanning System

With a subsystem that immediately warns of unstable operating conditions within the station or plant being controlled, the RW-300 digital control computer is available from Thompson Ramo Wooldridge Inc.

The system scans all instruments without interrupting the computer's control calculations. Abnormal trends are indicated when plant instrument readings deviate from prescribed limits.

When an out-of-limit instrument reading is detected, the computer immediately notifies the operator and initiates control action necessary to restore normal operating conditions.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

Automatic Chart Changer

An automatic chart changer for circular chart recorders has been developed by Barton Instrument Corporation. The changer makes it possible for a recorder to operate unattended for up to 16 days, using a 24-hour chart for each day.

A chart plate holds the plate and a chart scroll moves the used chart out of the way of the succeeding one without interrupting the recording sequence. Recorder case holds used charts until they are replaced with new ones. The entire operation is automatic. The changer is available as an integral part of Barton's Model 202A Recorder, or it comes in a kit form to other models.

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

Plastic Pipe

A new plastic pipe has been introduced by E. I. DuPont De Nemours & Company. Made of "Delrin" acetal resin, the pipe

Quality *costs less* in the long run!

BJ Pipeline Pumps

For high pressure, high temperature and high speed pumping, an extra safety factor is built into this DVMX Pump—*the safety of a quality product!*

Clean and compact, BJ's advanced design allows double-row bolting to prevent interstage leaking or bowing at the parting flanges. Double volute and symmetrical construction furnishes both radial and axial balance under all operating conditions. Near centerline mounting maintains perfect alignment at all temperatures.

Mid-America Pipeline

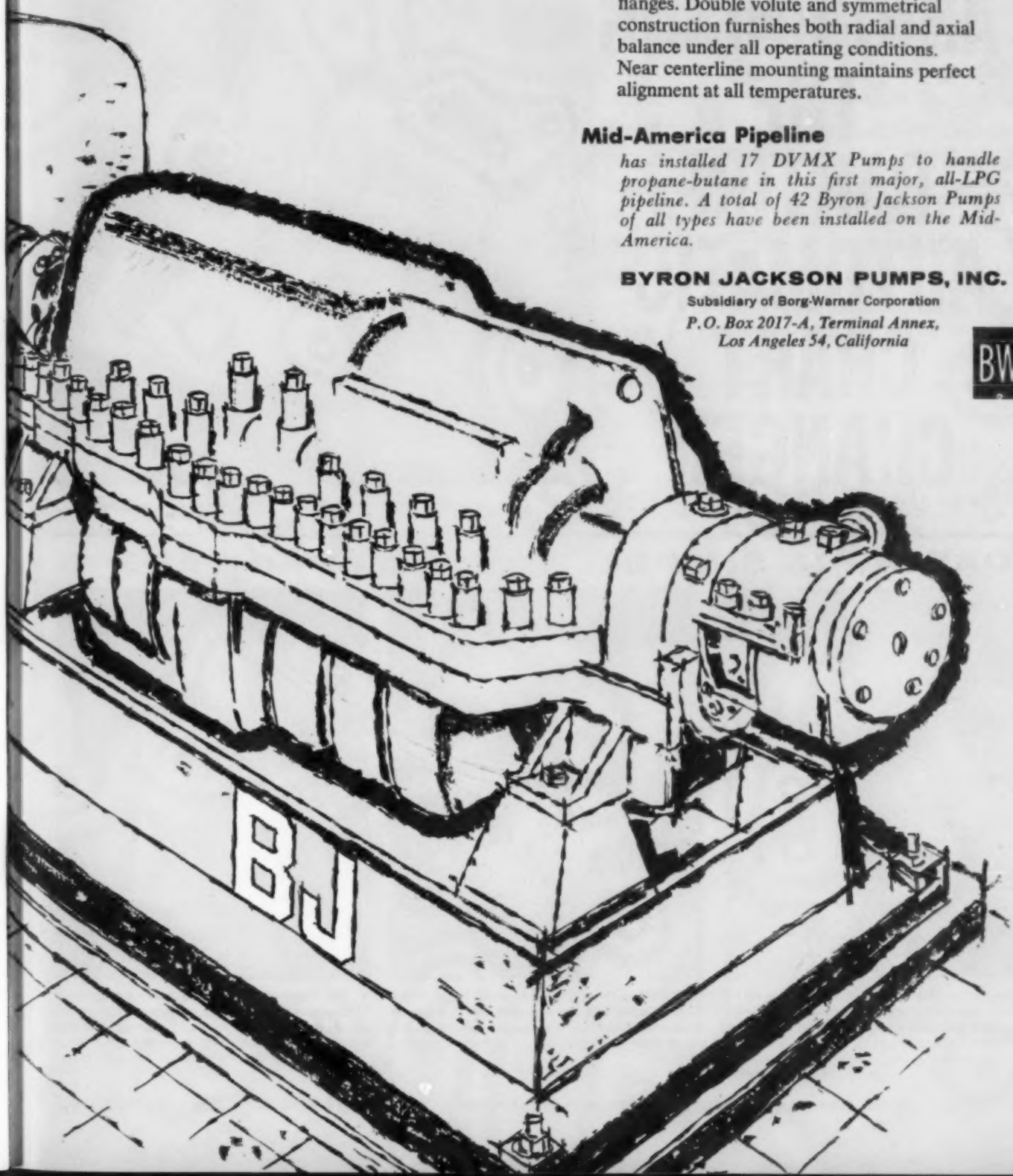
has installed 17 DVMX Pumps to handle propane-butane in this first major, all-LPG pipeline. A total of 42 Byron Jackson Pumps of all types have been installed on the Mid-America.

BYRON JACKSON PUMPS, INC.

Subsidiary of Borg-Warner Corporation

P.O. Box 2017-A, Terminal Annex, Los Angeles 54, California

BW



ANNOUNCING THE BARTON AUTOMATIC CHART CHANGER

LOADING IS SIMPLE...

1. The Barton chart changer will hold up to 16 patented, split charts. A locating pin on the chart plate makes it virtually impossible to load incorrectly.

2. With the scroll assembly and the pens mechanically lifted and locked out of the way, the loaded chart plate is quickly mounted onto the chart drive shaft.

3. The scroll assembly and pens are lowered and locked into place. There is nothing to adjust, nothing to go wrong. Capillary pens are supplied by ink bottle inside the case.

HANDLES UP TO 16 CHARTS; AUTOMATICALLY CHANGES TO A NEW CHART ON EACH REVOLUTION OF THE CHART DRIVE

Now your recorders can operate for up to 16 days, *untended*, and still produce a separate 24 hour chart for each day. The amazing new Barton chart changer eliminates the need for manual chart changing; it does the job *automatically* and *by itself!* Simple and foolproof both in handling and operation, the Barton chart changer *simplifies your accounting* by providing exact, consistent accounting periods, *cuts down your labor costs* by drastically reducing the frequency of your chart routes, *increases the readability of your records* by making it possible to select the optimum chart rotation for each application. Available in complete, ready-to-install kit form (it fits the Barton 202 and 202A recorders, the Bristol series 500 case, and the American Types D and A cases) the Barton chart changer will not jam, miss charts, or allow the recorded charts to be damaged. It is completely dependable, as reliable as the recorder. For complete information, see your Barton man or send in the coupon today.

Gentlemen: Please send me your free bulletin on the new Barton Chart Changer.

NAME _____

COMPANY _____

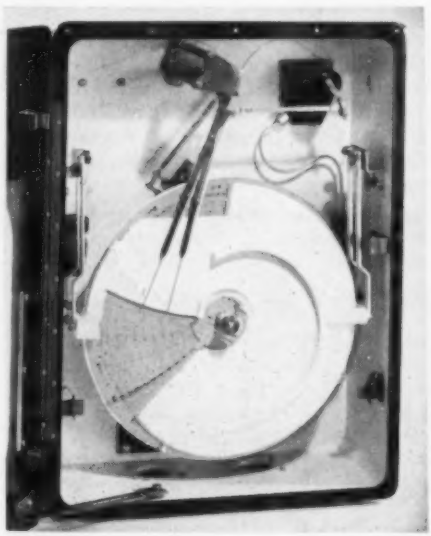
ADDRESS _____

CITY _____ ZONE _____ STATE _____

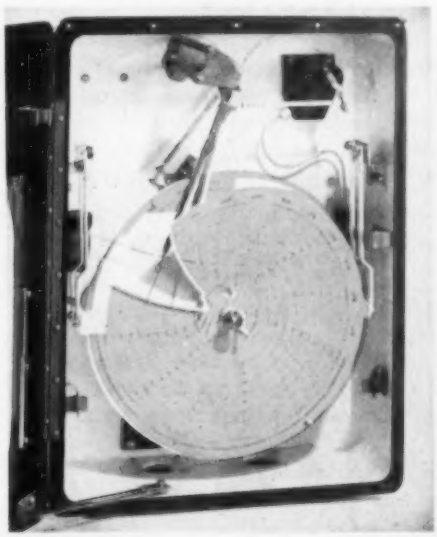
BARTON® INSTRUMENT CORPORATION

580 MONTEREY PASS ROAD • MONTEREY PARK, CALIFORNIA

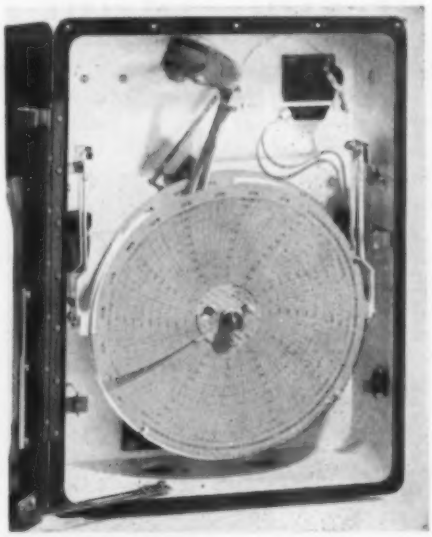
OPERATION IS SURE!



1. With the chart changer in position, the recorder is ready to operate. A portion of the chart (in green for illustration) shows from behind the scroll. Note the tab on the chart has just been picked up by the scroll knife edge.



2. As the chart drive rotates, the portion of the chart that has been recorded is spun onto the shaft and well away from the pens which are now recording on the last part of the chart.

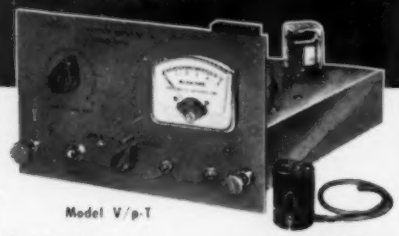


3. The first chart has now completed its cycle and is held for storage on the shaft, clear of the pens, which are now recording on the newly exposed second chart. The pens begin recording on the new chart at the precise moment the first chart completes its rotation.

Indikon

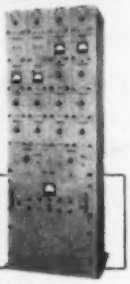
VIBRATION MONITOR

FAST — RELIABLE — FIELD TESTED
Indication aids detection of developing failure. Automatic higher set-pt. during start-up provides continuous protection. No time delay relay required to override. Responds in ½-sec., yet avoids false shutdowns.



Model V/p-T

- DOUBLE POLE 5-AMP CONTACTS
- Set-pt. covers 0-to-5 mils (or higher)
- 48 volts or 60 volts DC operation.
- Vibration sensed by rugged self-generating magnetic pickup.



INDIKON provides integrated systems for **PRESSURE, TEMPERATURE** and **VIBRATION** protection and indication. Typical installation at right.

Send for descriptive bulletin

THE INDIKON COMPANY
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has been tested in gathering lines, flow lines, and other services since 1958. The pipe features a simple heat-fusion fastening method which yields an integral joint of high strength. Delrin is a thermoplastic designed to combine strength and toughness with fatigue endurance under pressure surging conditions.

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

Valve Actuator

A new Robotarm valve actuator, designed to allow positive remote control of any type rotary operation of butterfly, ball or plug valve has been introduced by Bettis Corp. The units are manufactured in several sizes with from 750 to 300,000 inch-pounds of opening and closing torque at 100 psi air pressure.

The hydraulically operated actuator is enclosed and sealed, and can be furnished in some sizes with fail safe spring returns.

For more data, circle **No. E8** on Readers' Service Card, last page this issue.

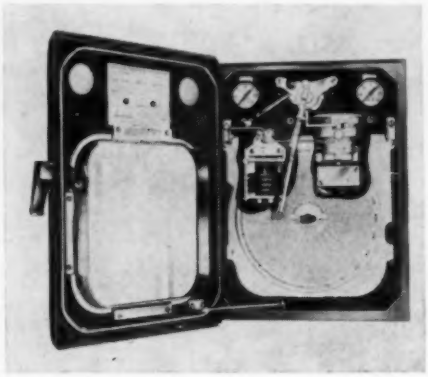
Interference Checked

A technique for solving problems of radio-frequency interference from high power microwave transmitters has been developed by General Electric Company's Tube Department.

The technique for making waveguide power filters effectively eliminate RFI caused by harmonics. Filters absorb unwanted harmonic signals produced by all transmitting tubes, but still allow the intended fundamental frequency to pass through with its power undiminished.

Designed primarily for use in high-power transmitters, the filters are available in ranges from 400 to 6,000 megacycles.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.



Pneumatic Controller

A recording pneumatic controller featuring good frequency response, low air consumption, high exhausting capacity, high tolerance to shock and high temperature stability has been announced by Bristol Company.

The Series 532 has a choice of four modes of control and works with any Bristol standard measuring elements for control of pressure, temperature, flow, humidity, or differential liquid level. The unit case is a compact 14¾-inch by 10¾-inch die cast aluminum with a fully gasketed weather resistant door. Recording is on an 8-inch round chart. All standard chart rotations from 8-hour to 7-day are available.

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

Electrical Pressure Gage

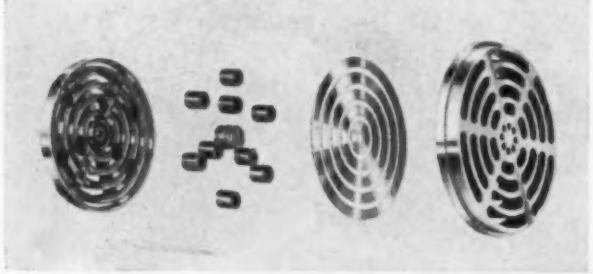
Utilizing a small pressure transducer, an electrical pressure gage suited to remote measurement, alarm or control of pressure from 0 to 2,500 psi has been introduced by Hastings-Raydist, Incorporated. The electrical output can be used for recording also.

The unit features a transducer that responds rapidly to pressure changes and will withstand tremendous shock and vibration without damage. Operation is from 115-volt ac, 60-cycle line.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

VOSS VALVES will mean
LESS MAINTENANCE
FEWER SHUTDOWNS
for your COMPRESSORS

Voss Valves are made to specification, machined from solid stock (not cast)—using best alloy steels; for corrosion condition—stainless steels, such as 410, 18-8 or non-ferrous alloys—monel, inconel, etc. Plates are machined (not stamped) and ground for precise close tolerance fit; are dimensionally stable . . . ductile . . . resist fracture, high temperatures and corrosion . . . withstand fatigue. Springs of heavy rectangular sections and large diameters add to dependability and safety.



- up to 40% more valve area
- minimum pressure loss
- higher efficiency
- less power consumption
- normal discharge temperature
- quiet, vibration-free
- utmost safety
- lower operating costs

For detailed proposal send name, bore, stroke and speed of machine.

J.H.H. VOSS VALVES
REG. U.S. PAT. OFF.

J. H. H. VOSS Co., Inc.
785 East 144th Street,
New York 54, N. Y.

When portable electric power is vital, you can't afford to gamble on "accident prone" parts. Only Onan offers so many safeguards against breakdown: Stellite valves, oversize bearings, shorter-stronger connecting rods and crankshafts. Equally important, *only* Onan is Performance Certified to deliver *all* the power promised by its nameplate.

Only Onan is certified to give you all the power promised by its nameplate

It's a fact that many electric plants on the market today do not deliver the output promised by their nameplate rating.

Every Onan plant is given a rugged workout *under full load* before it is shipped—*your assurance* that the Onan you buy is ready for hard work the day you get it.

But this isn't enough. Independent laboratory inspectors pull surprise inspections to double-check our tests and testing methods. They pull a plant off the line, run it, stop it, load it, overload it, check and recheck. Their torture test gives positive proof of Onan's quality. End result: *Onan's exclusive Performance Certification* . . . your assurance of getting every watt of power you pay for.

So when you're tempted by an electric plant "bargain," make sure its nameplate rating is not "inflated." Be sure you're getting full measure for your money. Remember, *the electric plant that short-changes you in power output is no bargain at any price!* Only Onan is Performance Certified to deliver everything the nameplate promises.

See Onan electric plants soon. Compare before you buy. You'll find your Onan distributor listed in the Yellow Pages. Call him or write direct.

PERFORMANCE CERTIFIED
We certify that when properly installed and operated this Onan electric plant will deliver the full power and the voltage and frequency regulation promised by its nameplate and published specifications. This plant has undergone several hours of running-in and testing under realistic load conditions, in accordance with procedures certified by an independent testing laboratory.
Onan
Onan

World's Leading Builder of Electric Power Plants

Onan

ONAN Division, Studebaker-Packard Corporation, 2691 University Ave. S. E., Minneapolis 14, Minn.

MASONEILAN
ELECTROPNEUMATIC POSITIONER...

Arranges Happy Marriage

Between Electronic Controller and Pneumatic Control Valve

The advantages of the electronic controller can now be mated to the superior power and smooth throttling action of the pneumatic control valve by means of Masoneilan Model 8010 Electropneumatic Positioner — the most advanced device available for converting electric output signal to pneumatic positioner output.

Fidelity of positioning is assured because Model 8010 is a true positioner providing *direct* comparison of valve stem position with controller output signal, resulting in dynamic response and accuracy *not possible with any combination of transducer and positioner.*

Compatibility with any presently available electronic controller is obtainable because design provides for adaptability to all usual controller output signals.

Character of the design results in high open-loop gain and closed-loop stability. Balanced beam permits installation of the valve in any position without calibration shift.

You Are Invited to join the growing number of users who recognize the superior merits of Masoneilan Electropneumatic Positioners. The first step — obtain complete information. Get in touch with any Mason-Neilan office or representative; or write direct to

MASONEILAN

Products that work for your profit

MASON-NEILAN

Division of Worthington Corporation

61 Nahatan Street, Norwood, Massachusetts

DESIGN FEATURES

- Extra large stabilized magnet, plus efficient magnetic circuit, provides high-force changes.
- External stroke adjustment accessible without removal of cover — no exposure of electric wiring.
- High capacity relay for fast stroking speeds. Relay may be mounted in any one of four positions to facilitate piping.
- Balanced beam permits installation of valve in any position without shift in calibration.
- Available for 3-15 psi or 6-30 psi valve spring ranges and for split-ranging. Standard stroke ranges ⅜" – 3" and 2" – 4". Others available.
- Available with direct or reverse action and for direct or reverse actuators.
- Explosion-proof construction meets requirements of Class I, Division I, Group D.

PERFORMANCE DATA

Open-loop Gain* — approx. 100

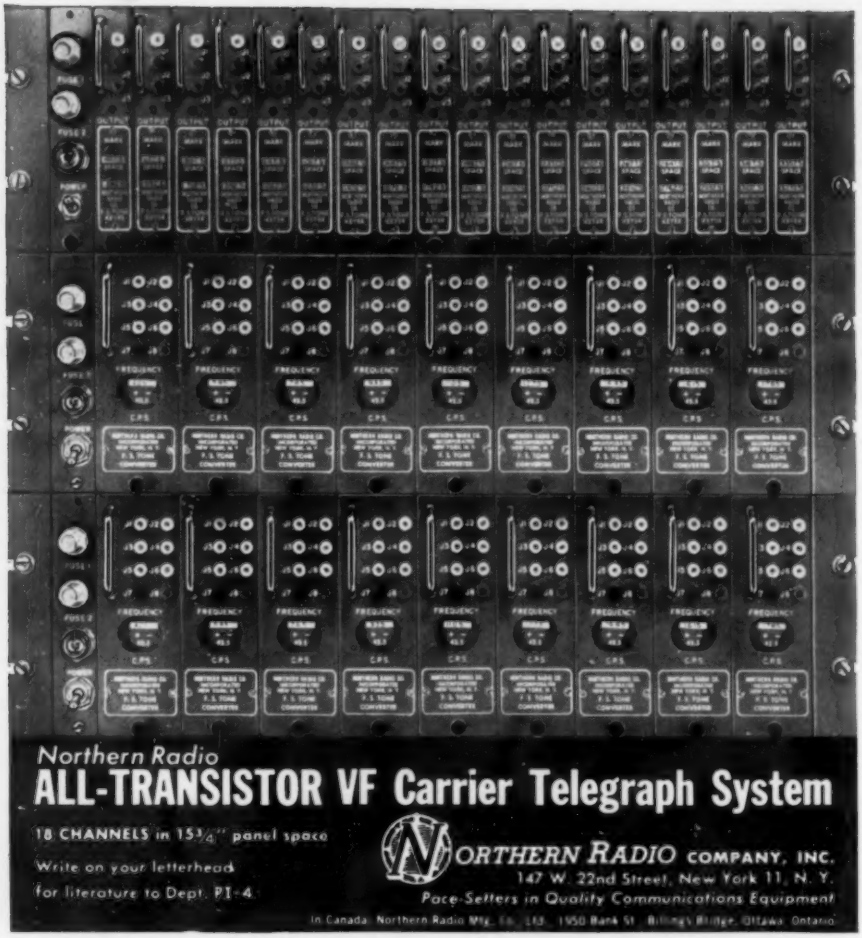
Linearity—within ±1% of full stroke

Repeatability — within 0.2%

Load Sensitivity — output pressure change of 1.2 psi per 0.1% of full stroke offset

Supply Pressure Effect — ±1% of full stroke for ±5 psi change from 20 psi

*Defined as $\frac{\%\text{ of full stroke}}{\%\text{ of full input range}}$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ALL-TRANSISTOR VF Carrier Telegraph System
18 CHANNELS in 15¾" panel space
Write on your letterhead
for literature to Dept. PI-4
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Pace-Setters in Quality Communications Equipment
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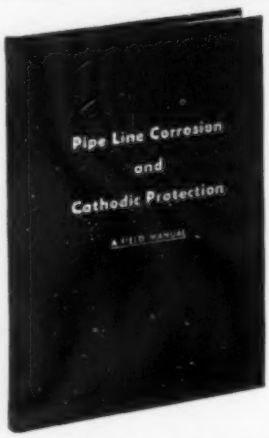

The most practical on-the-job manual for men concerned with pipe line corrosion.

Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This book is designed as a practical field manual. It provides workable methods that can save you valuable time and effort in obtaining interpretive field data.

Contents (Condensed). Soil Resistivity Surveys, Pipe-to-Soil Potentials, Line Currents, Current Requirement Surveys, Rectifier System for Coated Lines, Ground Bed Design and Installation, Magnesium Anodes on Coated Lines, Hot Spot Detection, Stray Current Electrolysis, Interference in Cathodic Protection, Operation and Maintenance, Coating Inspection and Testing.

Appendices cover: Fundamentals of Underground Corrosion, Basic Principles of Cathodic Protection. Plus . . . tables and properties of metals, attenuation equations and index.

108 pages, illustrated. . . . Price $3.00

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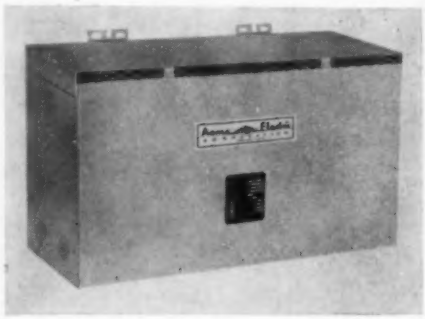
Tape Reduces Handling

A mobile, low-cost data handling system, which will eliminate the need for complex installations, has been introduced by Radiation, Inc. It is designed to reduce industrial data handling costs, and provide a vital new capability to many companies.

The system called Radac I, will collect critical data on speeds, fuel flow, temperatures, pressures and many other variables that must be measured during processing and production. Moreover, Radac I will itself process and prepare this information for direct entry into most common computers.

Normally, raw test data must traverse a chain of large, expensive data processing systems before it is in the proper format for computer entry and analysis by scientists and engineers. The Radac I system eliminates the need for such complex equipment. It economically prepares specialized information on magnetic tape in formats for direct use with the IBM 650, 704, and 1260 systems, as well as the large IBM 7090 and other installations.

For more data, circle **No. E12** on Readers' Service Card, last page this issue.



Shielded Transformers

For use in hazardous locations, a new line of shielded winding transformers is available from Acme Electronic Corporation. It provides a simple shield between input and output windings to permit grounding.

The transformers are designed for use in such areas where flammable volatile liquids or liquefied flammable gases are transferred from one container to another.

For more data, circle **No. E13** on Readers' Service Card, last page this issue.

Electronic Data Devices

Seven new devices are available with the Philco 2000 electronic data processing system. The additions are a high speed memory system; high speed data transmission links; real time scanner; interval timer

THERE'S A BIT OF SALT IN THE WIND

STUPP CORPORATION

MANUFACTURERS OF CUSTOM STEEL LINE PIPE
FOR THE OIL AND GAS INDUSTRY

P. O. BOX 2548 • BATON ROUGE, LOUISIANA

(formerly Cal-Metal Pipe Corporation of Louisiana)

It's not far to the Gulf of Mexico. The continent is slowly disappearing into the sea. Pipeliners are crossing a wilderness floodway dominated by the Atchafalaya River. The stream shoots the gap at the junction of the Red and Mississippi Rivers and reddogs it for the Gulf, cutting 90-foot-deep channels, sometimes knocking a dozen bayous backwards out of their banks. With boots, boats and a big string of barges these pipeliners will handle the job. A big advantage is the use of Stupp Corporation *high-yield strength, lightwall steel line pipe.* Handles easier, faster. Exceeds highest industry standards. Requires up to 34 fewer field welds per mile. Saves thousands of dollars on jobs anywhere. *The tougher the job, the greater the saving.* For a quotation on steel line pipe in the 6 5/8- to 16 inch range, lengths up to 64 feet, call, write or wire Stupp Corporation.

Sales Offices: BATON ROUGE, LA. • HOUSTON, TEXAS • TULSA, OKLA. • DENVER, COLO. • JACKSONVILLE, FLA.

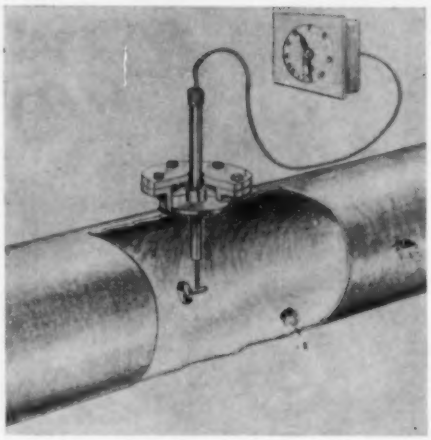
unit; auto control unit; accounting clock system and tape translator.

For more data, circle **No. E14** on Readers' Service Card, last page this issue.

Flow Transducer

For measurement of fluid flows in large pipe lines, Ramapo Instrument Company, Inc., has developed the Mark V flow transducer. Operating in form of a probe, the unit is unlimited in line size and flow rates applicability. It can be installed by one man, without special equipment, through a flanged fitting fabricated in the line.

The transducer can be located in remote areas and the signal telemetered. System can be provided to permit indicating, recording, controlling, and totalizing flows. The unit senses the rate of fluid flow as a product of the dynamic forces acting upon a fixed body immersed in the flow stream.



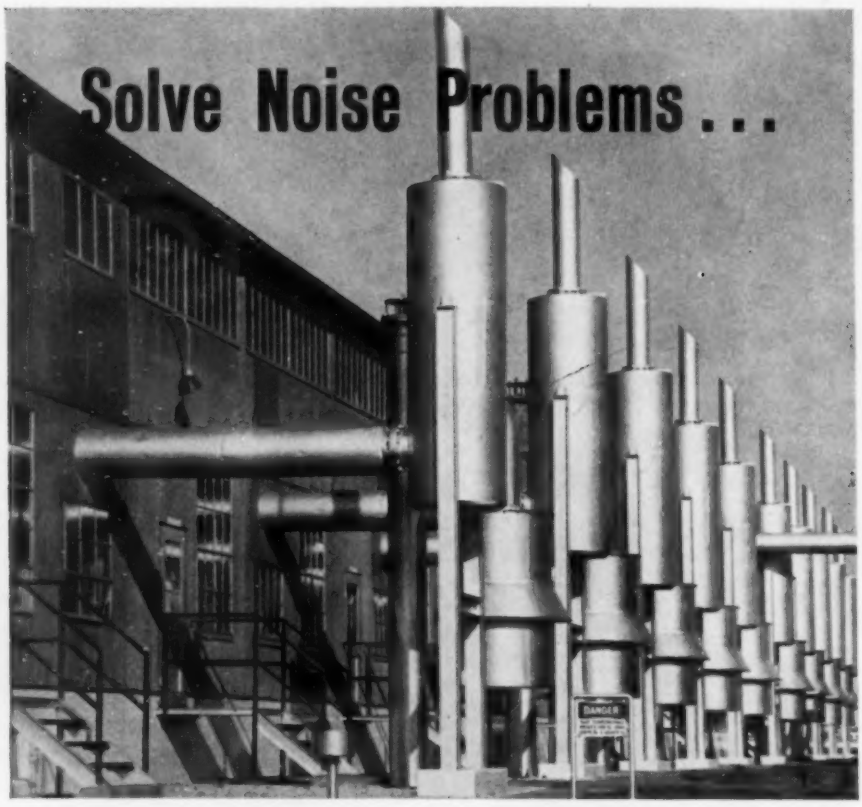
For more data, circle **No. E15** on Readers' Service Card, last page this issue.

Power Supply

A new compact, general purpose, wide-range, voltage regulated, 30-ampere dc power supply, incorporating silicon controlled rectifiers is announced by Christie Electric Corp.

Operating from a 115-volt, single phase, 60-cycle power source, the unit will deliver 50 ampere for one minute or 30 ampere continuous duty.

For more data, circle **No. E16** on Readers' Service Card, last page this issue.



. . . with a MAXIM ENGINEER on your team

There's no need to go-it-alone when your design problem deals with noise suppression. You can save time and money by putting a MAXIM engineer on your team.

He is a specialist in designing silencers to meet noise problems of all types of engines from giant diesels to "go-karts," as well as special purpose silencers for jet aircraft, atomic submarines, waste disposal plants, chemical plants and heat recovery applications.

Let us know your problems . . . we will work with your engineers . . . on your team . . . to solve them.

Immediate delivery on most standard type silencers from regional stocking points. Write or call today.

MAXIM BEAIRD DIVISION

THE J. B. BEAIRD COMPANY, INC.

A Subsidiary of American Machine & Foundry Company

Headquarters: P. O. Box 1115 Shreveport, Louisiana

Plants: Shreveport, Louisiana Clinton, Iowa

Sales agents in all principal cities and foreign countries.

Welding Electrode

Designed for difficult out-of-position work, a new welding electrode has been developed by A. O. Smith Corporation. A strengthened coating crater improves arc direction in horizontal and vertical working positions. The added strength also aids electrode penetration and welding efficiency. The SW 610 improved fusion characteristics also provide better resistance to breakdown in the last half of its operation. This reduces costly stub losses.

For more data, circle **No. E17** on Readers' Service Card, last page this issue.

What's Inside

If you haven't any idea of what's inside your pipe line and would like to have a look, Schutte and Koerting Company has a sight flow indicator for such a purpose. The indicator has double sight glasses for clear observation of the fluid even in poor lighting conditions. It uses machined recesses and retaining rings for even seating of the sight glass gaskets to prevent leakage. The units allow a look inside to determine if there is a flow and direction and condition of fluid.

For more data, circle **No. E18** on Readers' Service Card, last page this issue.

Closed Circuit TV

General Electric announces a new closed circuit television monitor series for communications within industrial plants. An expanded brightness range fits the monitors for operation in areas of high ambient

an ounce of prevention that really PAYS OFF...

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An ounce of prevention is worth a *ton* of cure . . . when it's an ounce of UNICOR.

Put 10 to 20 parts of this amazingly potent inhibitor in a million parts of crude or refined petroleum product . . . and see what happens: The UNICOR, an oil-soluble corrosion inhibitor, plates out on inner surfaces of pipeline and refinery vessels and tanks **. . . provides lasting protection against corrosion.**

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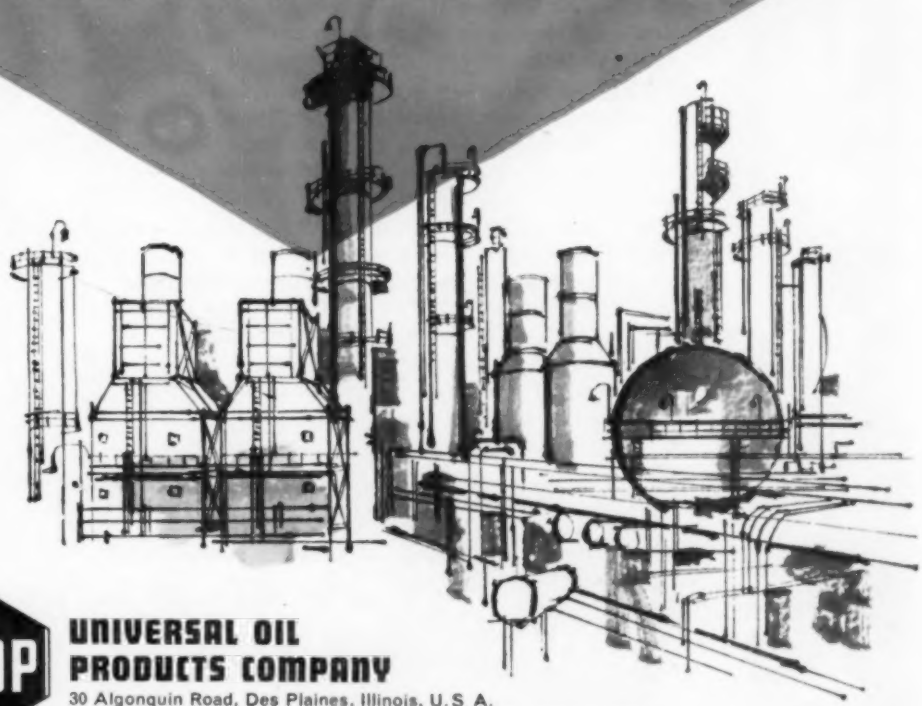

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Correct selection and most effective use of petroleum inhibitors and additives involves expert analysis and consideration of many factors. As specialists for over a quarter-century, UOP is able to provide unparalleled field service, brought to you by a member of our staff of Product Sales Engineers*. For detailed information on the UOP family of superior inhibitors and additives call or write our Products Department.

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WHERE RESEARCH TODAY MEANS PROGRESS TOMORROW

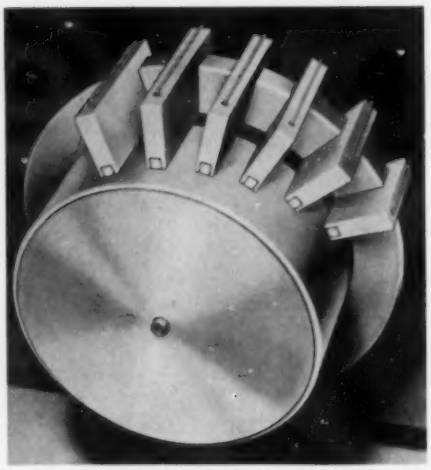
light. An accessory polarized safety glass faceplate for additional effectiveness in minimizing reflections and improving contrast ratio is available. Monitors have an 800-line minimum horizontal resolution.

For more data, circle **No. E19** on Readers' Service Card, last page this issue.

Delay/Memory System

A magnetic drum delay/memory system in a "building block" concept is available for process or equipment control systems. Basic to the Electron-Ohio, Inc., system is a 20-channel magnetic oxide drum with storage densities up to 9,000 discrete information bits per channel. Recording heads adjust circumferentially to provide continuously variable delays of from 2 to 60 seconds.

A modular-constructed console contains the drum, drum drive and power supply, record and playback heads, permanent magnet erase head and panel-mounted plug-in record and playback amplifiers.



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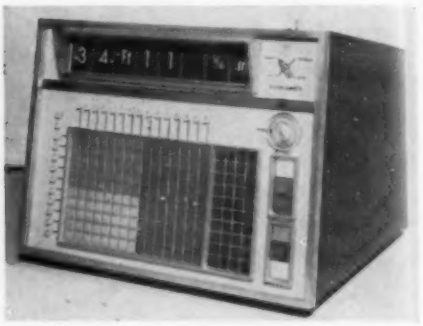


Telemetering System

A new "solid state" telemetering and supervisory control system is now available from Shand and Jurs Co. Designated RATE (Remote Automatic Telemetering Equipment), it utilizes solid state electronics to permit three basic functions, data gathering, constant alarm scanning and control, to be accomplished over a single economical low grade communications link.

Use of time-sharing techniques avoids the need for costly multi-channel systems—making possible a practical large scale continuous alarm scan. Data pertaining to temperature, pressure, positive displacement meter readings and other information is gathered at telegraph speeds.

For more data, circle **No. E21** on Readers' Service Card, last page this issue.

Antenna Cover

Tower Construction Co. has developed a parabolic antenna cover to protect antennas from buffeting of severe winter weather. The cover is cone shaped and made with molded fiberglas. It is designed to withstand wind force of 50 pounds per square foot. The Para-Dome is available for use with reflectors of 4 foot, 6 foot, 8 foot and 10-foot sizes.

(This item supplements Tower Construction Co. data on page 480 of the Pipe Line Catalog, Third Edition.)

For more data, circle **No. E22** on Readers' Service Card, last page this issue.

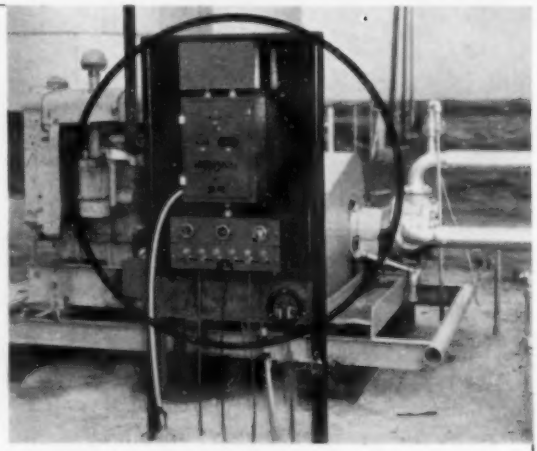
Scraper

Euclid, Division of General Motors, has announced its largest scraper. Payload capacity is 125,000 pounds. The model SS-40 is a six-wheel unit designed for high production jobs with long, high speed hauls at speeds up to 34 mph. It is powered by a GM 12-cylinder diesel engine of 432 hp.

All scraper operations are completely hydraulic with no cable connections. A new feature is the double ram actuated "Push-out, Roll-out" ejector.

For more data, circle **No. E23** on Readers' Service Card, last page this issue.

COMPLETELY AUTOMATED PIPELINE BOOSTER PUMP IN WEST TEXAS OIL FIELD.



MURPHY

Murphy-matic Engine Controller automatically starts and stops pump engine on high and low suction pressures with OPL-SS pressure switch.

When gathering system starts pumping into main line, suction pressure builds up to hit high contact on OPL-SS pressure switch. This activates circuit in Murphy-matic Engine Controller—starts engine—idles it until warm—and then speeds up engine and automatically engages clutch.

When gathering system pumps out and line pressure drops, low pressure contact activates "stop" circuit in Engine Controller. Engine slows down, disengages clutch, idles to cool off—and then stops. And it's ready for another automatic start.

Also has complete "tattletale switch" system to indicate engine and pump trouble such as low oil pressure, high water temperature, over-load, over-speed, over-crank, high discharge pressure shutdown and low discharge pressure shutdown in case of line break.

Any degree of automation is possible with standard, mass-produced Murphy switch gauges. Submit details of any specific problem to our engineers for a simple, low cost solution. Complete catalog available on request.

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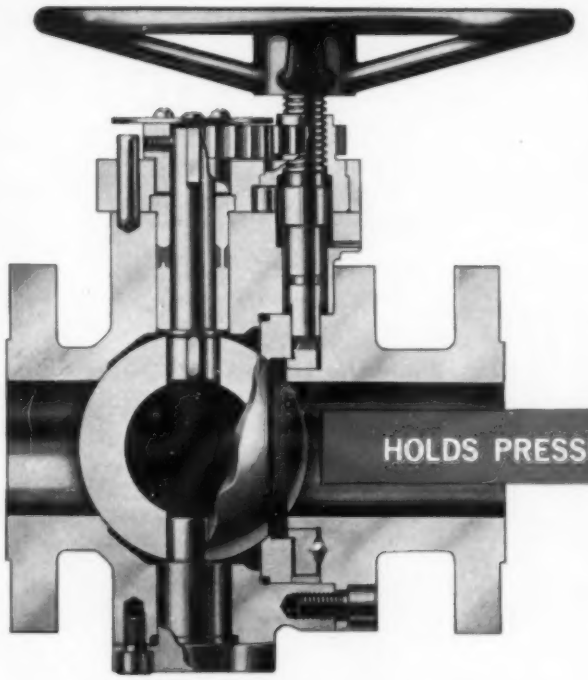

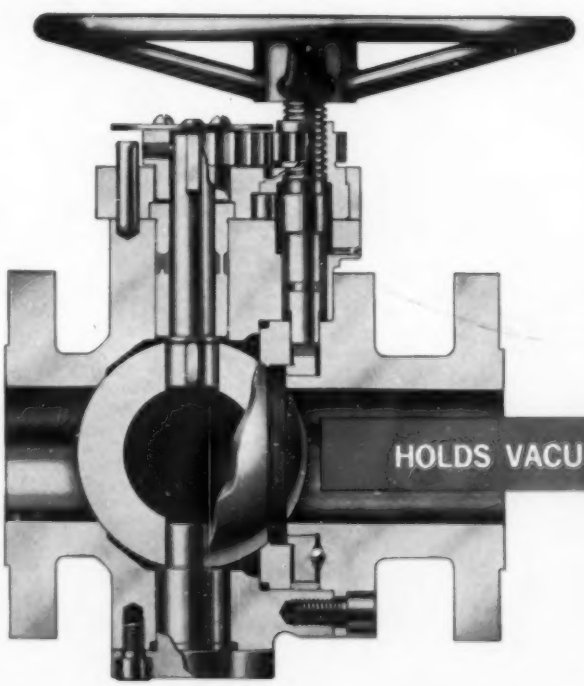

HYDRIL BALL PLUG Type "K" VALVES

Controlled sealing . . . a new concept in valve design . . . is the secret of Hydril's tight, bubble-proof shutoff. Hydril Ball-Plug Valves always seal positively against pressure from either direction—or against vacuum—because the fully confined packing ring is mechanically compressed between plug and seat when the valve is closed. This tightly compressed gasket type seal easily bridges clearances between parts as well as surface imperfections. Result: seal efficiency is unimpaired by prolonged hard usage, by rust or sediment.

Design of Hydril Type "K" Ball Plug Valves assures minimum maintenance costs. Non-lubricated, they employ no sealing lubricants. There's no sliding friction between plug and body to produce wear and abrasion.

The spherical plug is mounted on accurately positioned bearings, maintaining a minimal controlled clearance between plug and body. This contributes to easy, free-turning operation as well as to long service life.

●

Hydril valves are available in a wide range of sizes and ratings. Worm-gear and motor-operated models can be supplied. Get the full story on Hydril Valves from your nearby representative . . . or write Hydril Company for free Catalog No. V-60.

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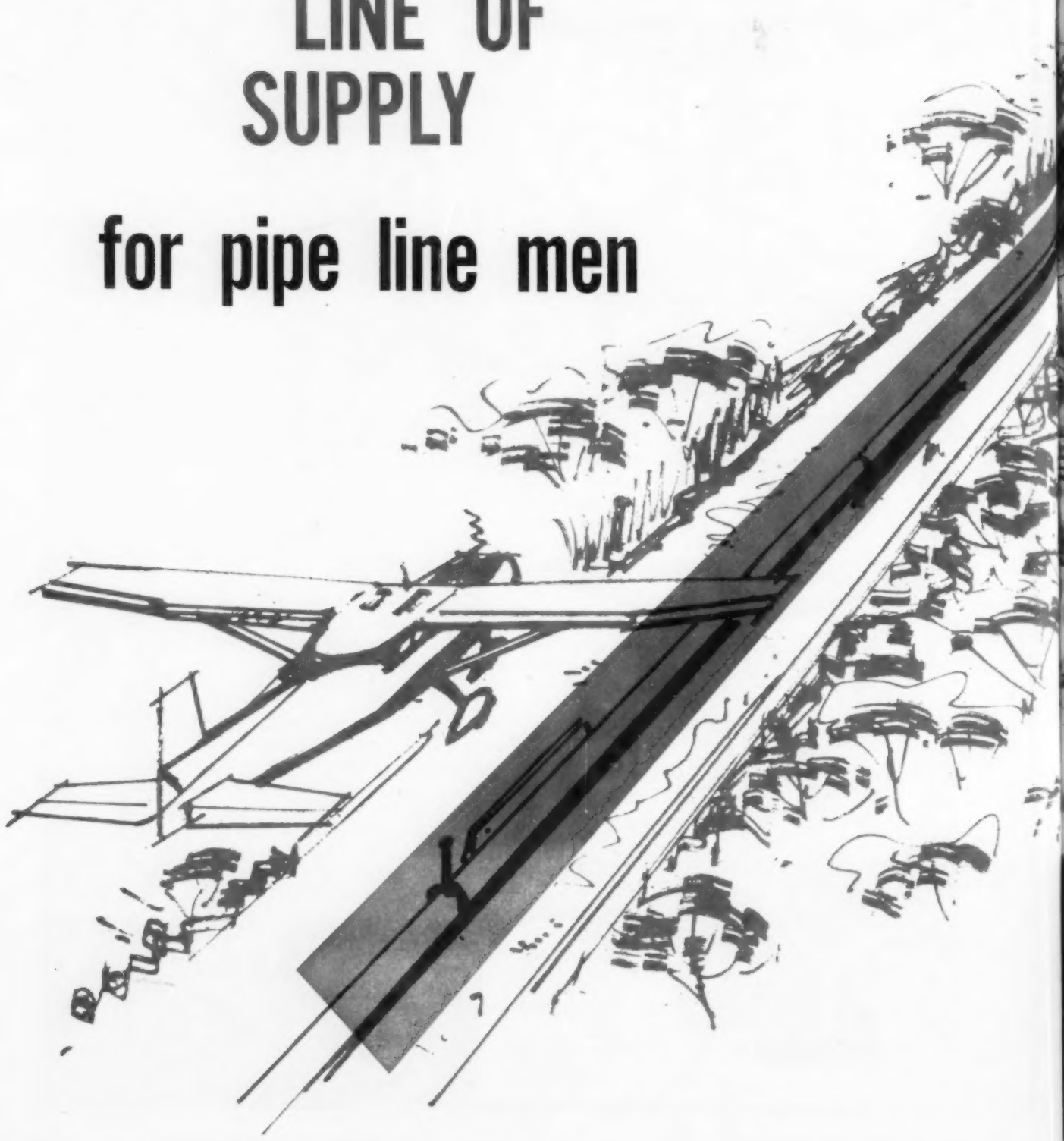

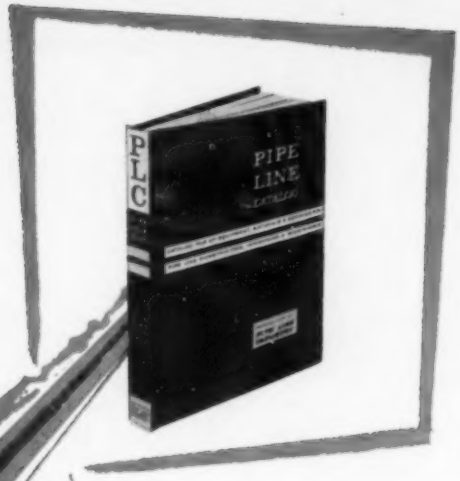

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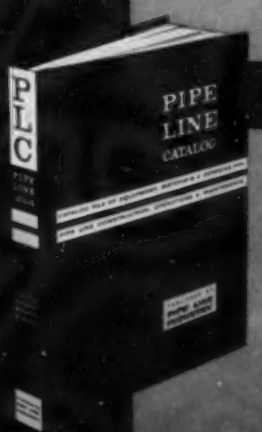

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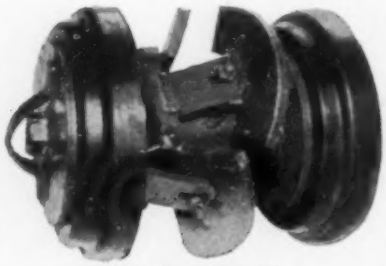
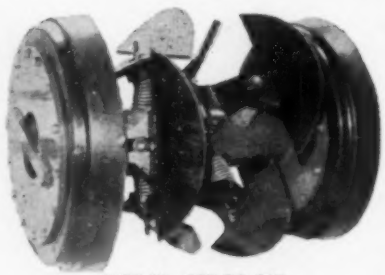


TYPE HI—6" TO 18"



TYPE HI—20" TO 36"

TYPE HI—6" to 36"

The latest development in pipe cleaning tools.

CONSTRUCTION

These springs extend through the center of the unit to blades on the opposite side of the unit which gives it a maximum of flexibility. The heavy springs on this unit help to keep it centered in the pipe supporting its own weight which will give far greater cup life.

DESIGN

This unit is ideal for first run on new construction, or for extremely corroded pipelines.

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New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers' Index. Simply circle code numbers of items desired—sign and mail card.

Standby Power

A booklet giving detailed information, illustrations and specifications on diesel engine driven generator units especially applicable for electricity generation on continuous or standby basis has been issued by Ruston & Hornsby.

Units are powered by Ruston YE diesel in ranges from 50 to 175 hp with electric battery starting and are provided with special features in connection with standby applications for radio and telecommunications needs.

To get a copy, circle **No. E24** on Readers' Service Card, last page this issue.

Industrial Telemetering

Containing fundamentals of the company's approach to remote control, Dresser Electronics, SIE Division, has published a detailed booklet on industrial telemetering.

It includes sections on telemetering transceivers, coding, synchronous bit interval timing, speed of transmission, putting the receiver to work, and solid state devices.

To get a copy, circle **No. E25** on Readers' Service Card, last page this issue.

Interface Detection

A two-page bulletin has been released by the Ohmart Corp. concerning its method of detection of interfaces by nuclear gaging systems. The bulletin discusses the present type detectors with Ohmart Corp.'s unit and explains several other applications with specific installation and operation data.

To get a copy, circle **No. E26** on Readers' Service Card, last page this issue.

Microwave System

Lynch Communication Systems, Inc., has issued a 12-page bulletin describing its microwave communication system. The system consists of radio (RF equipment), multiplexing (channeling equipment) and the necessary antennas, towers, buildings, etc. for each station.

Toll circuit quality can be obtained for up to 600 channels over as short a distance as 5 or 10 miles and as long as 1,000 miles. The system is available for operation in common carrier band, industrial band and government band.

To get a copy, circle **No. E27** on Readers' Service Card, last page this issue.

Field Compressors

Clark Bros. Co. has issued a bulletin on its Veepac Model TVM packaged compressors. These are 2-cycle, turbocharged, gas-engine driven compressors with V-type engines and horizontally opposed compressor cylinders for gas gathering, offshore mounting, small transmission stations, repressuring and other services.

The units are offered in 10 and 12 cylinder models rated at 825 and 1,000 hp. The package is mounted on a single skid, a duplex skid or as a stationary unit.

To get a copy, circle **No. E28** on Readers' Service Card, last page this issue.

Line Pipe

A 28-page brochure on A. O. Smith Corporation's line pipe has been published by the company's Tubular Division. The illustrated booklet describes manufacturing facilities and quality control of the product. It follows the pipe process from pickling, through pipe forming and flash welding, mechanical expansion and loading and shipping.

Tables of sizes and weights, covering wall thickness, fraction inches, and decimal inches are included. Weights are given in pounds per foot, per 40-foot lengths and per mile ton.

To get a copy, circle **No. E29** on Readers' Service Card, last page this issue.

Electrical Codes

Crouse-Hinds Condulets and the National Electrical Code are discussed in a new 60-page bulletin detailing the applications of condulets in hazardous locations. Code articles 500-503 are quoted, along with Crouse-Hinds recommendations for condulets meeting the various code requirements. The bulletin is illustrated with drawings and photographs.

To get a copy, circle **No. E30** on Readers' Service Card, last page this issue.

Pressure Regulators

Specifications on reliance type HPC pressure regulators for reducing applications are described in a new bulletin released by American Meter Company.

Designed with secondary guides and isolator plates, both types are recommended as primary regulators for use with ammonia and for general service in gasoline plants and refineries.

To get a copy, circle **No. E31** on Readers' Service Card, last page this issue.

Flowmeter

A metering system comprised of a magnetic flowmeter and an indicator/recorder which measures fluids with conductivities as low as 0.1 micromhos/cm is described in an eight-page bulletin released by Fischer & Porter Company.

Details are given on materials of construction, mounting and capacities of the primary elements.

To get a copy, circle **No. E32** on Readers' Service Card, last page this issue.

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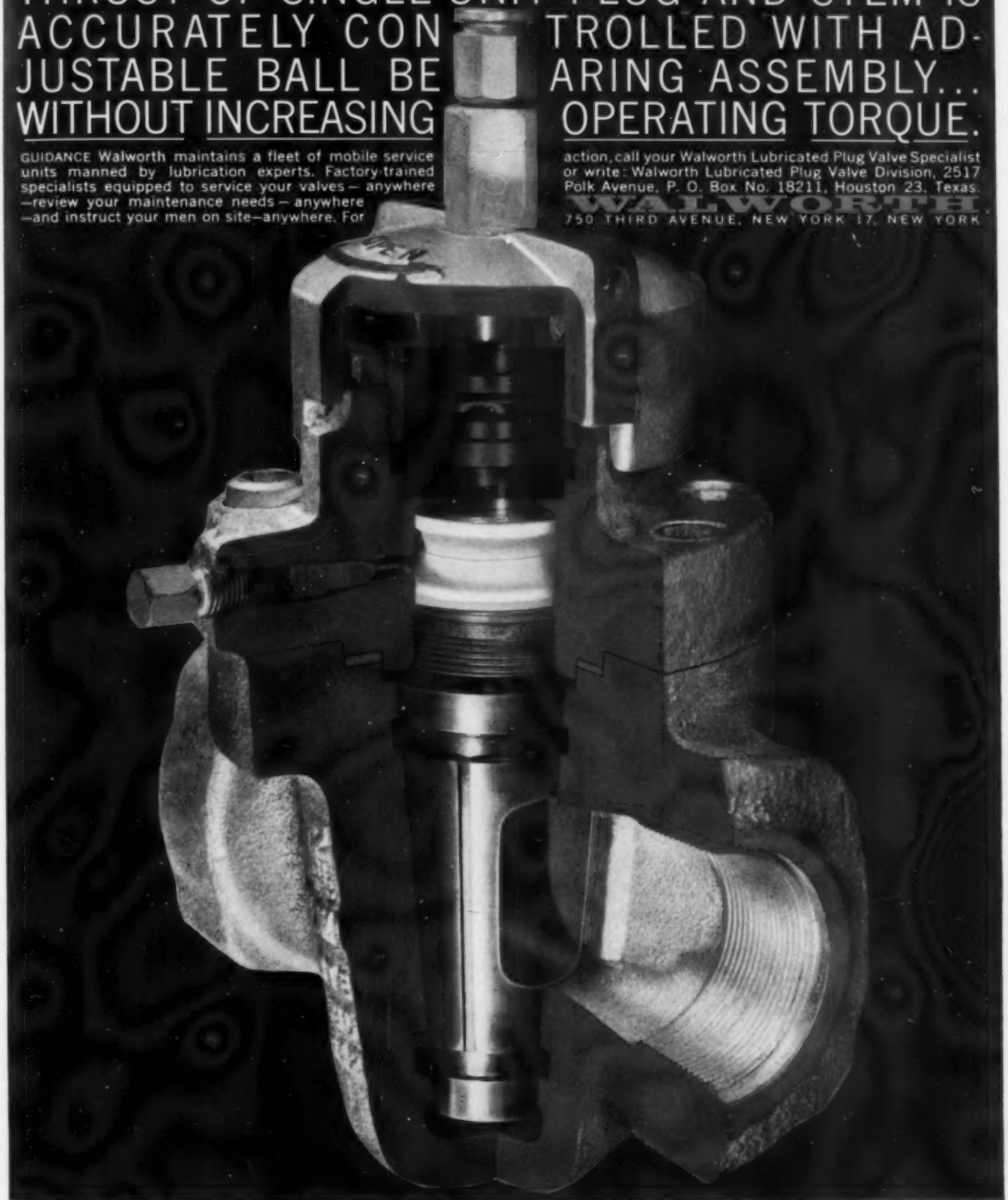

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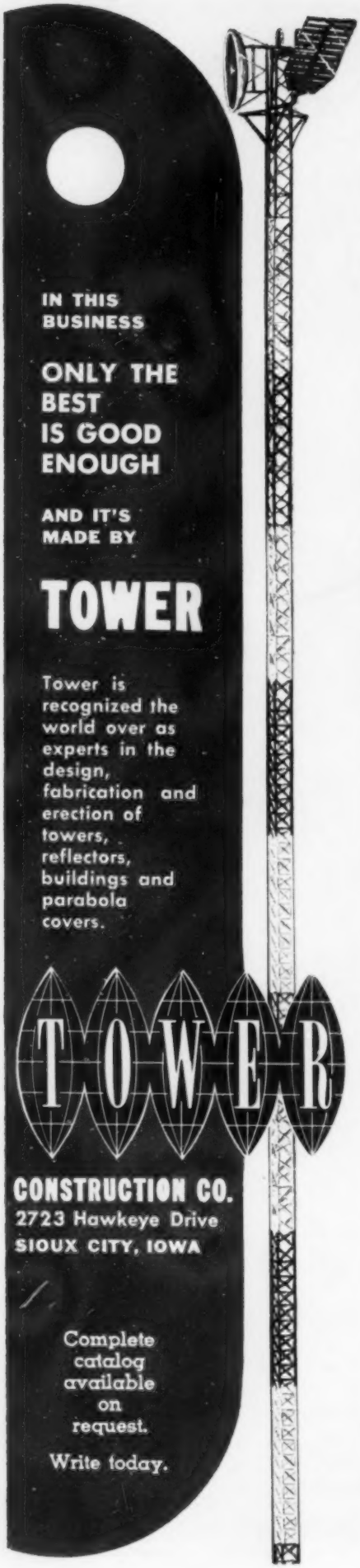
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• Dot preceding name of advertiser indicates that detailed data on products and services of the firm will be found in current (1960-61) third revision of The Pipe Line Catalog.

A

• Aerotec Industries, Inc. 97
Aerovent Fan Co.
Large Propeller Division 81a
Allied Chemical Corp.
General Chemical Division 85c
American Air Filter Co. 10

B

Barton Instrument Corp. 102-103
• The J. B. Beaird Co. 110
• Bethlehem Steel Co. 22-23
• Bonney Forge & Tool Works 25
The Bristol Company 21
• Byron Jackson Pumps Inc.
Division Borg-Warner Corp. 101

C

• Caterpillar Tractor Co. 9
• A. B. Chance Co. 89
• Clark Bros. Co.
One of the Dresser Industries 90-91
Classified 97
• The Cooper-Bessemer Corp. 11
• Crose-Perrault Equipment Corp. 82
W. H. Curtin & Co. 83a

D

• Dresser Industries, Inc. 90-91

F

Fisher Governor Co. 32
Fleet-Line Co. 118b
Fluor Products Co.
Division The Fluor Corp. 79
Ford Motor Co. 18-19

G

• Gardner-Denver Co. 7
Garlock, Inc. 17
• Gaso Pump & Burner Mfg. Co. 95
General Chemical Division
Allied Chemical Corp. 85c
General Dynamics Corp. 93
Greenhead, Inc. 34
• Grove Valve & Regulator Co. 122
• Gulf Publishing Co. 108b

H

Houston Contracting Co. 8
Humble Oil & Refining Co. 13
• Hydril Co. 113

I

The Indikon Co. 104a
International Harvester Co. ..... 75 and 98-99

J

• Jo-Bell Products, Inc. 84a
Jones & Laughlin Supply Division 14-15

K

Klein, Schanzlin & Becker AG 30

L

Leschen Wire Rope Division
H. K. Porter Company, Inc. 6
Link-Belt Speeder Corp. 26-27
Lone Star Steel Co. 2

M

Magnetrol, Inc. 81b
Majestic Contractors Ltd. 92
• F. H. Maloney Co. 87a
• Mason-Neilan Division
Worthington Corp. 106-107
• C. A. Mathey Machine Works, Inc. 85a
• The Mercoid Corp. 80
Minneapolis-Honeywell 31
• Mixing Equipment Co. 33
Mortoren-Werke Mannheim AG 87b
• Frank W. Murphy Manufacturer, Inc. 112

N

• Nicolet Industries, Inc. 24
• Northern Radio Co. 108a

O

• Oil Well Supply Division
United States Steel 121
Onan Division
Studebaker-Packard Corp. 103

P

• Pipe Line Catalog 114-115
• The Pipe Line Development Co. 83b
Pipeline Cleaners Co. 116
• Pipeline Inspection Co. 86
Pittsburgh Chemical Co. 96
H. K. Porter Company, Inc. 6
H. C. Price Co. 5

R

Radio Corporation of America 77
• Rockwell Manufacturing Co. 28-29

S

Safety Gas Main & Stopper Co. 94
Sharman, Allen, Gay & Taylor Inc. 73
• M. B. Skinner Co. 84b
Solar Aircraft Co.
Subsidiary International Harvester Co. 75
• Steel Forgings, Inc. 76
• Stewarts and Lloyds Ltd. 78
Stromberg-Carlson Division
General Dynamics Corp. 93
Studebaker-Packard Corp. 105
Stupp Corporation 109

T

• Taylor Instrument Companies 12
• Tower Construction Co. 118a

U

UGC Instruments ..... 16 and 88
United States Steel Corp. 121
• Universal Oil Products Co. 111

V

• J. H. H. Voss Co. 104b

W

• Walworth Co. 117
Williams Brothers 85b
• T. D. Williamson, Inc. 20
• Worthington Corp. 106-107

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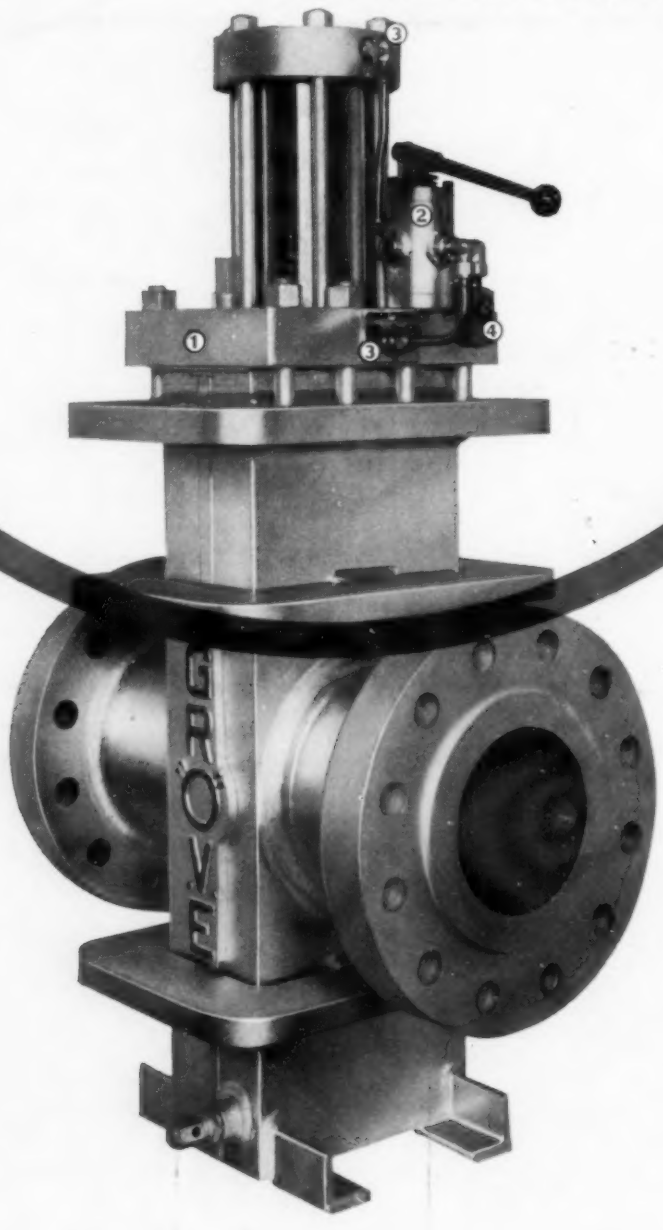
Now from one source, Seal-"O"-Ring® gate valves with an extremely compact cylinder operator. With fewer parts than conventional units, the operator's reduced size is achieved through designing the valve stem to act also as a piston rod, bringing the cylinder very close to the valve bonnet (1). In some sizes, the valve bonnet actually becomes the lower cylinder head of the operator. The operator comes equipped with a specially designed four-way valve (2) which controls the cylinder. Utilizing line pressure, fluid is applied to either end (3) moving the piston and gate to the open or closed position. A variable orifice (4) in the discharge controls operating speed. Designed for general pipeline service, where ease of operation and/or remote control is necessary.

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